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THE ABACÁ PROJECT OF LA CARLOTA EXPERIMENT STATION

By ANSELMO F. LABRADOR
Agricultural Assistant

The first work on abacá at La Carlota Experiment Station was mostly the raising of two or three of the Negros abacá varieties for fiber to make into ropes for tying animals. This was back in 1897. The Kinosol and Lono varieties of abacá were then the most popular varieties. The fiber was extracted by tenants working on share systems.

In October, 1907, as the available records of the Bureau of Agriculture show(1), abacá seeds from neighboring haciendas and other places were planted in the station between rows of sugar cane and in seed beds. The plants grown between the rows of sugar cane were irrigated.

The station started to distribute rootstocks, suckers, and seedlings of different varieties of abacá in 1915.

The work was increased as facilities permitted. In January, 1912, Nickles(2) reported that a series of experiments at La Carlota Experiment Station in Occidental Negros had been started to determine some of the many points wherein this plant is capable of improvement. In 1914, he reported that these experiments were far from complete, but already they had proved instructive.

Among the experiments performed during the past which have brought results have been the variety tests, flowering tests, planting tests, extracting fiber tests, breaking strength tests of fiber, plant seed selection, and the growing of abacá seedlings.

The results obtained from variety tests, extracting fiber tests, and breaking strength tests of fiber caused the elimination of a number of undesirable varieties of abacá. Plant seed selection lead to improvements in the desirable varieties of abacá and the growing of abacá seedlings made possible the raising of many seedling varieties which are still under test for their adaptability, quality of fiber, yield, etc.

VARIETY TESTS

Variety tests were started in 1912 with the object in view of finding out what varieties are suited to conditions at La Carlota and at the same time to see which give a high per cent of fiber.

Different varieties of abacá taken from different abacá regions—ten varieties from Mindanao, eleven from Leyte, five from Negros, and eight from Southeastern Luzon—were used. These varieties were planted twice in two fields. The first planting was made on October 31, 1912, and the second on June 21, 1916. The planting distances were three meters between the rows and three meters between the plants in the row. In the first planting seedlings and suckers were used but only the suckers were subjected to the tests, while in the second planting only suckers were used. All plants were given the same cultural treatment. They were irrigated during the dry seasons until the dam was washed away by a strong flood on October 14, 1919. Since then the abacá plants have suffered greatly from lack of water during the dry seasons.

Other plantings were made in other fields of some of these varieties only and different kinds of seed were used, so the data here reported are from the two fields where the same varieties were planted.

Ten hills were selected and labeled from each of the different varieties. Tests were made only on the selected hills. The stalks were harvested after the flower buds had appeared. Each stalk was cut and weighed separately. The fiber obtained from each stalk was kept separate and then dried and weighed.

The following table shows the yearly yields from 10 hills and the per cent of fiber per stalk of the different varieties in the first planting:

Variety name	1916			1917		
	Number of stalks harvested from 10 hills	Yield of fiber per 10 hills	Average per cent of fiber per stalk	Number of stalks harvested from 10 hills	Yield of fiber per 10 hills	Average per cent of fiber per stalk
		Grams			*Grams*	
Agutay M.	5	165.0	1.12	32.0	273.4	.44
Alman L.	19	163.1	.42	35.0	143.1	1.13
Baguisanon Basag M.	33	267.2	.36	21.0	293.9	.96
Baguisanon Lawaan M.	5	259.0	1.11	30.0	314.0	.41
Bangulanon M.	10	361.0	1.20	26.0	404.4	.86
Bisaya N.	17	235.0	.46	50.0	114.1	1.89
Bulao SL.	2	310.0	.94	25.0	191.7	.46
Canorajan SL.	17	241.0	.49	96.0	307.7	.17
Ilayas SL.	32	234.0	.25	65.0	109.0	.18

Variety name	1916			1917		
	Number of stalks harvested from 10 hills	Yield of fiber per 10 hills	Average per cent of fiber per stalk	Number of stalks harvested from 10 hills	Yield of fiber per 10 hills	Average per cent of fiber per stalk
		Grams			*Grams*	
Inosa L.	15	235.2	.54	52.0	235.3	.34
Itehinbalud L.	14	290.0	.40	35	250.0	.41
Itom SL.	3	196.3	.93	12	131.0	1.00
Kala-ao N.	43	118.0	.07	52	112.0	.11
Kinosol N.	16	230.0	.49	55	209.8	.19
Lagurhuan Burawen L.	5	133.0	.76	37	177.0	.47
Lagurhuan Dagami L.	43	122.0	.15	74	109.0	.15
Laguis L.	11	293.0	.97	38	176.5	.42
Liahon L.	40	134.0	.18	58	100.0	.22
Libutanay L.	16	206.1	.89	27	286.0	.76
Libuton M.	20	365.0	.50	24	375.0	.53
Linawaan L.	5	286.0	.85	12	268.0	.47
Lono N.	16	248.0	.42	37	193.3	.33
Maguindanao M.	8	505.0	.97	28	292.0	.55
Mininonga L.	9	376.0	1.22	37	63.0	.60
Moro N.	17	129.6	.34	60	202.6	.20
Pula SL.	5	97.0	.61	84	188.1	.18
Pulajan M.	6	236.0	.65	35	233.1	.32
Punucan M.	18	410.4	.55	20	258.1	.16
Puti-tomatagacan SL.	19	61.6	.08	87	117.0	.17
Sinaba M.	14	289.0	.72	41	381.0	.61
Sinamoro L.	13	194.0	.39	10	300.0	.13
Sinamoro Puti SL.	8	125.0	.79	74	130.0	.19
Sugmod SL.	11	277.4	.45	72	137.0	.23
Tabono	......	......	......	......	......	......
Tangongon M.	5	976.0	1.33	20	833.3	.68

Variety name	1918			1919		
	Number of stalks harvested from 10 hills	Yield of fiber per 10 hills	Average per cent of fiber per stalk	Number of stalks harvested from 10 hills	Yield of fiber per 10 hills	Average per cent of fiber per stalk
		Grams			*Grams*	
Agutay M.	9	219.7	1.63	6	99.5	1.78
Alman L.	12	138.1	1.43	6	58.0	1.29
Baguisanon Basag M.	11	192.9	1.52	5	81.0	1.81
Baguisanon Lawaan M.	11	851.3	1.58	8	149.3	1.62
Bangulanon M.	12	358.5	2.49	7	90.8	2.52
Bisaya N.	11	228.5	1.01	6	70.8	1.22
Bulao SL.	11	177.6	1.32	9	62.7	1.52
Canorajan SL.	11	350.0	1.57	11	158.0	1.61
Ilayas SL.	12	119.8	.79	12	64.0	.97
Inosa L.	11	192.6	1.55	7	91.0	1.63
Itehinbalud L.	12	249.1	1.18	6	78.0	1.52
Itom SL.	11	112.7	1.11	11	63.9	1.41
Kala-ao N.	12	120.0	.46	10	54.0	.65
Kinosol N.	10	184.1	1.17	6	88.5	1.14
Lagurhuan Burawen L.	9	177.0	1.77	6	30.5	1.23
Lagurhuan Dagami L.	10	96.0	.81	4	31.5	1.30
Laguis L.	12	157.0	1.63	6	63.0	1.67
Liahon L.	12	103.5	1.06	4	28.0	1.22
Libutanay L.	12	208.0	2.17	7	56.7	1.78
Libuton M.	13	33.7	1.51	10	45.4	1.31
Linawaan L.	10	248.0	1.09	6	64.0	1.23
Lono N.	11	182.4	1.06	6	57.8	1.19
Maguindanao M.	12	363.0	1.77	6	185.0	1.83
Mininonga L.	13	217.5	1.92	5	85.8	1.89
Moro N.	12	172.4	1.09	7	55.6	1.08
Pula SL.	12	118.0	1.20	12	49.5	1.77
Pulajan M.	12	183.7	1.36	6	71.5	1.51
Punucan M.	13	29.6	1.49	7	25.8	1.58
Puti-tomatagacan SL.	12	149.0	1.31	11	71.0	1.58
Sinaba M.	12	384.0	1.96	10	94.0	1.80
Sinamoro L.	10	230.8	1.62	6	84.3	1.54
Sinamoro Puti SL.	12	139.1	1.25	11	63.0	1.48
Sugmod SL.	13	303.7	1.49	7	124.0	1.54
Tabono	......	......	......	......	......	......
Tangongon M.	12	295.1	2.44	3	101.0	2.07

Variety name	1920			1921		
	Number of stalks harvested from 10 hills	Yield of fiber per 10 hills	Average per cent of fiber per stalk	Number of stalks harvested from 10 hills	Yield of fiber per 10 hills	Average per cent of fiber per stalk
		Grams			Grams	
Agutay M	1	54.0	1.56	1	40.0	1.67
Alman L	1	20.0	2.00	......	......	......
Baguisanon Basag M	1	20.0	2.50	......	......	......
Baguisanon Lawaan M	......	......	......	......	......	......
Bangulanon M	......	......	......	......	......	......
Bisaya N	2	21.5	.52	......	......	......
Bulao SL	3	38.3	1.28	......	......	......
Canorajan SL	10	84.6	1.32	2	53.5	.99
Ilayas SL	7	28.8	.70	3	26.0	.58
Inosa L	2	52.5	1.31	......	......	......
Itehinbalud L	......	......	......	......	......	......
Itom SL	7	31.3	1.07	......	......	......
Kala-ao N	7	53.0	.46	......	......	......
Kinosol N	......	......	......	......	......	......
Lagurhuan Burawen L	......	......	......	......	......	......
Lagurhuan Dagami L	4	24.2	.79	2	57.0	.94
Laguis L	......	......	......	......	......	......
Liahon L	2	25.0	1.01	1	18	.47
Libutanay L	2	30.0	1.14	......	......	......
Libuton M	1	40.0	1.33	......	......	......
Linawaan L	3	66.6	1.00	2	120.0	.84
Lono N	......	......	......	......	......	......
Maguindanao M	......	......	......	......	......	......
Mininonga L	......	......	......	......	......	......
Moro N	......	......	......	......	......	......
Pula SL	6	77.0	1.01	4	38.0	.91
Pulajan M	3	36.6	.85	......	......	......
Punucan M	......	......	......	......	......	......
Puti-tomatagacan SL	9	33.4	1.21	4	37.0	1.12
Sinaba M	1	80.0	1.60	......	......	......
Sinamoro L	3	41.0	1.27	......	......	......
Sinamoro Puti SL	9	29.7	1.25	2	40.0	1.02
Sugmod SL	8	39.9	1.46	2	29.0	1.41
Tabono	......	......	......	......	......	......
Tangongon M	1	109.0	1.69	......	......	......

M=Mindanao; L=Leyte; SL=Southeastern Luzon; N=Negros.

The first planting was first harvested when the plants in each variety were about four years old. And the yields of the different varieties of abacá were high the fourth, fifth, sixth, seventh, and eighth year and from then on the yields of some varieties declined and others even ceased. The lack of irrigation was partly responsible for this.

The following table shows the yearly yields of 10 hills and the per cent of fiber per stalk of the different varieties in the second planting:

Variety name	1918			1919		
	Number of stalks harvested from 10 hills	Yield of fiber per 10 hills	Average per cent of fiber per stalk	Number of stalks harvested from 10 hills	Yield of fiber per 10 hills	Average per cent of fiber per stalk
		Grams			Grams	
Agutay	......	......	......	4	5.0	1.55
Alman	8	75.0	.92	10	35.2	.98
Baguisanon Basag	1	70.0	1.14	2	10.0	1.04
Baguisanon Lawaan	3	147.0	1.24	10	87.0	1.24
Bongolanon (Bangulanon)	1	160.0	2.29	8	95.0	2.00
Bisaya	7	78.9	1.14	8	61.0	1.12

Variety name	1918			1919		
	Number of stalks harvested from 10 hills	Yield of fiber per 10 hills	Average per cent of fiber per stalk	Number of stalks harvested from 10 hills	Yield of fiber per 10 hills	Average per cent of fiber per stalk
		Grams			*Grams*	
Bulao	1	85.0	1.10	4	25.0	1.52
Canorajan	4	59.0	1.46	9	26.0	1.43
Ilayas	11	45.0	1.36	11	24.0	1.71
Inosa	2	100.0	1.37	10	56.6	1.56
Itehinbalud	3	65.0	1.36	6	12.0	1.64
Itom	5	50.0	1.21	7	17.0	1.19
Kala-ao	9	79.5	.49	10	38.3	.63
Kinosol	7	96.0	1.04	12	71.0	1.04
Lagurhuan Burawen	3	120.0	1.73	7	43.0	1.53
Lagurhuan Dagami	8	25.0	1.06	7	19.0	1.13
Laguis	....	....	....	3	47.0	1.77
Liahon	8	360.0	.91	8	30.0	.97
Libutanay	4	50.0	1.25	7	41.0	1.72
Libuton	7	130.0	1.68	9	86.0	1.38
Linawaan	3	144.0	1.44	6	75.6	1.41
Lono	8	96.2	1.53	8	57.0	1.23
Maguindanao	2	240.0	1.58	6	67.0	1.61
Mininonga	6	103.0	1.76	8	44.0	1.80
Moro	4	87.0	1.15	11	65.0	.94
Pula	5	27.0	1.45	8	17.6	1.48
Pulahan	....	....	....	8	56.0	2.37
Punucan	7	150.0	1.39	9	112.0	1.41
Puti-tomatagacan	1	10.0	1.67	3	15.0	2.33
Sinaba	7	117.0	2.14	6	52.0	1.64
Sinamoro	6	62.0	1.07	7	55.0	1.33
Sinamoro Puti	1	50.0	1.28	8	24.0	1.34
Sugmod	3	288.0	1.79	8	38.0	1.47
Tangongon	2	500.0	1.70	8	148.0	2.05

Variety name	1920			1921		
	Number of stalks harvested from 10 hills	Yield of fiber per 10 hills	Average per cent of fiber per stalk	Number of stalks harvested from 10 hills	Yield of fiber per 10 hills	Average per cent of fiber per stalk
		Grams			*Grams*	
Agutay	2	30.0	1.85	....	....	....
Alman	2	15.0	.73	1	10.0	.71
Baguisanon Basag	....	....	....	....	....	....
Baguisanon Lawaan	4	41.2	1.32	1	55.0	1.02
Bongolanon (Bangulanon)	6	47.0	2.02	1	90.0	2.14
Bisaya	6	33.0	1.24	1	70.0	0.89
Bulao	1	10.0	1.67	....	....	....
Canorajan	8	28.0	1.33	3	33.1	1.14
Ilayas	6	16.3	1.04	2	6.0	.61
Inosa	4	41.2	1.15	....	....	....
Itehinbalud	4	12.0	1.39	....	....	....
Itom	3	13.0	1.09	....	....	....
Kala-ao	7	25.4	.61	7	35.0	.43
Kinosol	7	36.6	.95	2	21.0	.62
Lagurhuan Burawen	7	68.0	1.60	1	15.0	1.00
Lagurhuan Dagami	4	11.0	1.05	....	....	....
Laguis	....	....	....	....	....	....
Liahon	1	100.0	.76	2	135.0	.79
Libutanay	2	40.0	1.09	....	....	....
Libuton	5	21.0	1.12	2	60.0	1.44
Linawaan	2	32.5	1.28	1	20.0	1.33
Lono	8	26.0	1.51	1	25.0	1.47
Maguindanao	8	35.6	1.77	....	....	....
Mininonga	6	37.0	1.63	3	45.0	1.23
Moro	8	26.0	.99	....	....	....
Pula	2	85.0	1.31	....	....	....
Pulahan	2	41.0	1.89	....	....	....
Punucan	2	44.0	89	....	....	....
Puti-tomatagacan	....	....	....	....	....	....
Sinaba	5	19.0	1.54	1	30.0	2.00
Sinamoro	2	39.0	1.12	1	40.0	1.05
Sinamoro Puti	8	12.0	1.01	1	5.0	.83
Sugmod	7	12.0	1.24	4	25.0	1.10
Tangongon	7	85.0	1.98	....	....	....

As to the second planting, with the exception of the Agutay, Laguis, and Pulajan, the different varieties began to produce crops in their second year, but not being irrigated they did not produce good crops.

The following table shows the six-year averages in yields and average percentages of fiber per stalk of each variety:

Variety name	1916			1917		
	Number of stalks per 10 hills	Yield of fiber per 10 hills	Average per cent of fiber per stalk	Number of stalks per 10 hills	Yield of fiber per 10 hills	Average per cent of fiber per stalk
Agutay	5	165.0	1.12	32	273.4	.44
Alman	19	163.1	.42	35	143.1	1.13
Baguisanon Basag	33	267.2	.36	21	293.9	.76
Baguisanon Lawaan	5	259.0	1.11	30	314.0	.41
Bongolanon (Bangulanon)	10	361.0	1.20	26	404.4	.86
Bisaya	17	235.0	.46	50	114.1	1.89
Bulao	2	310.0	.94	25	191.7	.46
Canorajan	17	241.0	.49	96	307.7	.17
Ilayas	32	234.0	.75	65	109.0	.18
Inosa	15	235.2	.64	52	235.3	.31
Itehin-balud	14	290.0	.40	35	250.0	.41
Itom	3	196.3	.93	12	131.0	1.00
Kala-ao	43	118.0	.07	52	112.0	.11
Kinosol	16	230.0	.49	55	209.8	.19
Lagurhuan Burawen	5	133.0	.76	37	177.0	.47
Lagurhuan Dagami	43	122.0	.15	74	109.0	.15
Laguis	11	793.0	.97	38	176.5	.43
Liahon	14	134.0	.18	58	100.0	.22
Libutanay	16	206.1	.89	27	286.0	.76
Libuton	20	365.0	.50	24	395.0	.53
Linawaan	5	286.0	.85	12	268.0	.48
Lono	16	248.0	.42	37	193.3	.33
Maguindanao	8	505.0	.97	28	292.0	.55
Mininonga	9	376.0	1.22	37	63.0	.60
Moro	17	129.6	.34	60	202.66	.20
Pula	5	92.0	.61	84	188.1	.18
Pulajan	6	236.0	.65	35	233.1	.32
Punucan	18	410.4	.55	20	258.1	.66
Puti-tomatagacan	19	61.6	.08	87	117.0	.17
Sinaba	14	289.0	.72	41	381.0	.61
Sinamoro	13	194.0	.39	10	300.0	.13
Sinamoro Puti	8	125.0	.79	78	130.0	.19
Sugmod	11	277.4	.45	72	137.0	.23
Tangongon	5	976.0	1.33	20	883.3	.68

Variety name	1918			1919		
	Number of stalks per 10 hills	Yield of fiber per 10 hills	Average per cent of fiber per stalk	Number of stalks per 10 hills	Yield of fiber per 10 hills	Average per cent of fiber per stalk
Agutay	9	219.7	1.63	5	52.2	1.66
Alman	10	101.5	1.16	8	46.6	1.13
Baguisanon Basag	6	131.4	1.33	3	45.5	1.42
Baguisanon Lawaan	7	249.1	1.41	9	118.1	1.42
Bongolanon (Bangulanon)	6	259.1	2.39	8	92.9	2.26
Bisaya	9	153.7	1.07	7	65.9	1.17
Bulao	6	131.3	1.21	7	43.8	1.52
Canorajan	8	204.5	1.48	10	92.0	2.52
Ilayas	7	82.4	1.07	12	44.0	1.34
Inosa	9	146.3	1.46	9	73.8	1.59
Itehin-balud	8	157.0	1.27	6	45.0	1.58

Variety name	1918 Number of stalks per 10 hills	1918 Yield of fiber per 10 hills	1918 Average per cent of fiber per stalk	1919 Number of stalks per 10 hills	1919 Yield of fiber per 10 hills	1919 Average per cent of fiber per stalk
Itom	8	81.3	1.15	9	35.5	1.30
Kala-ao	11	99.2	.44	10	46.1	.64
Kinosol	9	135.1	1.08	9	78.2	1.09
Lagurhuan Burawen	6	148.5	1.75	6	36.7	1.33
Lagurhuan Dagami	9	60.0	.94	6	25.2	1.21
Laguis	12	157.0	1.63	5	55.0	1.72
Liahon	10	231.8	.95	6	29.0	1.09
Libutanay	8	129.0	2.71	7	48.9	1.75
Libuton	10	81.3	1.59	10	68.2	1.34
Linawaan	7	186.0	1.22	6	69.8	1.32
Lono	9	139.3	1.29	7	57.4	1.16
Maguindanao	7	301.0	1.67	6	121.0	1.72
Mininonga	9	160.2	1.83	7	64.9	1.84
Moro	8	129.7	1.12	9	60.3	1.01
Pula	9	72.5	1.32	10	33.1	1.63
Pulajan	17	183.7	1.36	7	63.7	1.98
Punucan	10	95.8	1.44	8	73.4	1.49
Puti-tomatagacan	7	79.0	1.49	7	43.0	1.95
Sinaba	9	250.0	2.95	8	73.0	1.70
Sinamoro	8	146.4	1.34	7	69.6	1.44
Sinamoro Puti	7	94.5	1.26	9	43.5	1.41
Sugmod	8	295.8	1.59	8	71.0	1.55
Tangongon	7	387.1	2.07	6	124.5	2.06

Variety name	1920 Number of stalks per 10 hills	1920 Yield of fiber per 10 hills	1920 Average per cent of fiber per stalk	1921 Number of stalks per 10 hills	1921 Yield of fiber per 10 hills	1921 Average per cent of fiber per stalk
Agutay	2	42.0	1.70	1	40.0	1.67
Alman	2	17.5	1.36	1	10.0	.71
Baguisanon Basag	1	20.0	2.50	......	......	......
Baguisanon Lawaan	4	41.2	1.32	1	55.0	1.02
Bongolanon (Bangulanon)	6	47.0	2.02	1	90.0	2.14
Bisaya	4	27.2	.87	1	79.0	.89
Bulao	2	24.1	1.48	......	......	......
Canorajan	9	56.3	1.32	2	28.3	1.06
Layas	7	22.1	.87	3	16.0	.59
Inosa	3	47.1	1.23	......	......	......
Itehin-balud	4	12.0	1.39	......	......	......
Itom	5	22.1	1.08	......	......	......
Kala-ao	7	36.2	.53	7	35.0	.43
Kinosol	7	36.6	.95	2	21.0	.62
Lagurhuan Burawen	7	68.0	1.60	1	15.0	1.00
Lagurhuan Dagami	4	22.6	.89	2	51.0	.94
Laguis	......	......	......	......	......	......
Liahon	2	62.0	.89	2	77.0	.68
Libutanay	2	35.0	1.12	......	......	......
Libuton	3	30.5	1.23	2	60.0	1.44
Linawaan	3	59.5	1.14	2	70.0	1.58
Lono	8	26.0	1.51	1	25.0	1.47
Maguindanao	8	35.6	1.77	......	......	......
Mininonga	6	37.0	1.63	3	45.0	1.23
Moro	8	26.0	.99	......	......	......
Pula	4	56.0	1.15	4	38.0	.91
Pulajan	3	38.8	1.37	......	......	......
Punucan	2	44.0	.89	......	......	......
Puti-tomatagacan	9	33.4	1.21	4	37.0	1.12
Sinaba	3	49.5	1.57	1	30.0	2.60
Sinamoro	3	40.0	1.19	1	40.0	1.05
Sinamoro Puti	9	10.8	1.12	2	22.5	.91
Sugmod	8	20.9	1.35	3	27.0	1.25
Tantongon	4	97.5	1.83	......	......	......

Variety name	Total and averages for six years					
	Number of stalks per 10 hills		Yield of fiber per 10 hills		Average per cent of fiber per stalk	
	Total	Average	Total	Average	Total	Average
Agutay	54	9	792.3	132.1	8.22	1.34
Alman	75	13	481.8	80.3	5.91	.99
Baguisanon Basag	64	13	758.0	151.6	6.37	1.27
Baguisanon Lawaan	56	9	1,036.4	172.7	6.69	1.12
Bongolanon (Bangulanon)	57	10	1,254.4	209.1	14.87	1.81
Bisaya	88	15	665.9	110.9	6.35	1.06
Bulao	42	8	700.9	140.1	5.61	1.12
Canorajan	142	24	929.8	155.0	7.04	1.17
Ilayas	126	21	507.5	84.6	4.80	.80
Inosa	88	18	737.7	145.5	5.23	1.05
Itehin-balud	67	13	754.0	150.8	5.05	1.01
Itom	37	7	466.2	93.2	5.46	1.09
Kala-ao	130	22	446.5	74.4	2.22	.37
Kinosol	98	16	710.7	116.5	4.42	.74
Lagurhuan Burawen	62	10	578.2	96.4	6.91	1.15
Lagurnuan Dagami	138	23	389.8	65.0	4.28	.71
Laguis	66	17	1,181.5	295.4	4.75	1.19
Liahon	118	20	633.8	105.6	4.01	.67
Libutanay	60	12	705.0	141.0	7.23	1.45
Libuton	79	13	1,000.0	166.7	6.63	1.11
Linawaan	35	6	939.3	156.6	6.59	1.10
Lono	78	13	689.0	114.8	6.18	1.03
Maguindanao	57	11	1,254.6	250.9	6.68	1.34
Mininonga	71	12	746.1	124.4	8.35	1.39
Moro	102	20	548.3	109.7	3.66	.73
Pula	116	19	479.7	79.9	5.80	.80
Pulajan	68	14	755.3	151.1	5.68	1.14
Punucan	58	12	881.7	176.3	5.03	1.01
Puti-tomatagacan	133	22	671.6	111.9	6.02	1.00
Sinaba	76	13	1,072.5	178.7	8.65	1.44
Sinamoro	42	7	790.0	131.7	5.54	.92
Sinamoro Puti	113	19	426.3	71.1	5.68	.95
Sugmod	110	18	829.1	138.2	6.42	1.07
Tangongon	42	8	2,468.4	493.7	7.97	1.59

The results of the six-year test were as follows:

1. Different varieties varied greatly in the number of stalks produced, yield of fiber, and the per cent fiber per stalk.

2. The average yearly number of mature stalks harvested from 10 hills ranged from 6 to 24; the variety Linawa-an produced the least, and the variety Canorajan the most.

3. The average yearly yields of dry fiber ranged from 65 grams to 493.7 grams from 10 hills. The variety Tangongon gave the highest and the variety Lagurhuan Dagami the lowest yield.

4. The average yearly percentages of fiber per stalk ranged from .37 per cent to 1.81 per cent. The variety Bongolanon (Bangulanon) gave the highest and the variety Kala-ao the lowest.

5. Considering 15 stalks as the average yearly number of stalks produced by 10 hills of a variety of abacá among the 34 varieties the following varieties produced stalks above the average number: Canorajan, Lagurhuan Dagami, Kala-ao, Puti-tomatagacan, Ilayas, Moro, Layahon (Liahon), Pula, Sinamoro Puti, Sugmod, Inosa, Laguis, Kinosol, and Bisaya.

The varieties that produced below the average number of stalks were as follows: Pulajan, Libuton, Lono, Itehinbalud, Baguisanon Basag, Alman, Sinaba, Libutanay, Mininonga, Punucan, Maguindanao, Lagurhuan Burawen, Agutay, Baguisanon Lawa-an, Bulao, Tangongon, Sinamoro, Itom, and Linawa-an.

6. Considering that 279.8 grams of dry fiber as the average yearly yield from 10 hills of one variety among the 34 varieties tried, the Tangongon and Laguis varieties produced above the average yield and the rest produced less than the average yearly yield.

7. Considering 1.09 per cent, as the average yearly percentage of fiber per stalk of one variety among the 34 varieties, the varieties Bongolanon (Bangulanon), Tangongon, Libutanay, Sinaba, Mininoñga, Agutay, Maguindanao, Baguisanon Basag, Laguis, Canorajan, Lagurhuan Burawen, Pulajan, Bulao, Baguisanon Lawa-an, Libuton, Linawa-an, and Itom produced above the average.

Those that produced below the average percentage of fiber per stalk (1.09) per cent were the Bisaya, Inosa, Lono, Punucan, Itehinbalud, Alman, Puti-tomatagacan, Sinamoro Puti, Sinamoro, Ilayas, Pula, Kinosol, Moro, Lagurhuan Dagami, Liahon, and Kala-ao.

The following table shows the average monthly number of stalks, fiber produced and per cent of fiber per stalk produced by 10 hills of the 34 varieties tested during the years 1916 to 1921, inclusive.

Date	Number of stalks	Yield of fiber	Per cent fiber	Average total rainfall	Average temperature
1916 to 1921, inclusive		*Grams*		*mm.*	
January	6	488	.76	117.4	25.25
February	5	556	.82	103.5	25.71
March	7	621	.72	41.6	26.38
April	7	539	.71	116.7	26.89
May	6	561	.78	320.0	26.39
June	6	619	.71	300.0	26.41
July	9	524	.37	487.8	26.01
August	8	582	.52	339.8	26.12
September	9	682	.43	434.1	25.96
October	10	704	.45	502.2	25.90
November	5	683	.85	235.6	25.94
December	4	636	1.09	113.9	25.45

It will be noted from the above table that the abacá plants produced their highest yields and the greatest number of matured stalks during the month of October, which had a total rainfall of 502.2 millimeters and a temperature of 25.9° C., and that in the month of January, with a rainfall of 117.4 millimeters and a temperature of 25.25° C., the abacá plants produced the lowest yields, but not the least number of matured stalks. The average

monthly number of matured stalks produced by 10 hills among the 34 varieties ranged from 4 to 10, and the average weight of clean dry fiber produced in grams by 10 hills each of the 34 varieties ranged from 488 to 704.

PLANTING TESTS

The testing of growing abacá by the use of rootstocks, suckers, and seedlings for planting was tried to determine which is the best material for planting purposes.

According to Doctor Mendiola(4) it is not proper to use the true seeds of abacá in variety tests. Suckers alone, or rootstocks alone, should be used, but not both. If suckers are used, it is easy to plant the same number in a hill. If rootstocks are used, big errors may creep in because sections of the roots may contain different numbers of "eyes" or vegetative buds. The same number of "eyes" should be planted in a hill.

Three fields were used in this test planted at different times but the same treatment was given to the plants in each.

The following table shows the behavior of the different varieties:

Variety name	1918			1919		
	Number of stalks harvested	Yield of fiber per 10 hills	Average per cent of fiber per stalk	Number of stalks harvested	Yield of fiber per 10 hills	Average per cent of fiber per stalk
SUCKERS						
Bangulanon	......	......	......	2	70.0	1.73
Canorajan	......	......	......	5	20.0	1.54
Inosa	......	......	......	3	131.0	1.38
Itehin-balud	3	97.0	1.32	8	34.0	1.28
Itom	2	82.0	1.17	9	49.0	.70
Kinosol	......	......	......	1	60.0	1.08
Laguis	......	......	......	5	35.0	1.47
Libutanay	4	99.0	1.30	9	55.6	1.73
Libuton	2	115.0	1.31	7	72.0	1.35
Linawaan	1	63.0	1.39	4	31.0	1.16
Lono	......	......	......	1	40.0	1.67
Maguindanao	......	......	......	5	59.0	1.43
Mininonga	3	153.0	1.47	8	57.0	1.48
Punucan	2	173.0	1.43	6	88.0	1.24
Sinaba	2	124.0	1.84	9	70.0	1.74
Sinamoro	1	75.0	1.41	6	41.3	1.44
ROOTSTOCKS						
Bangulanon	......	......	......	......	......	......
Canorajan	......	......	......	......	......	......
Inosa	......	......	......	......	......	......
Itehin-balud	......	......	......	......	......	......
Itom	......	......	......	......	......	......
Kinosol	......	......	......	......	......	......
Laguis	......	......	......	......	......	......
Libutanay	......	......	......	1	45.0	1.40
Libuton	......	......	......	1	47.0	1.13
Linawaan	......	......	......	3	53.0	.85
Maguindanao	......	......	......	......	......	......
Mininonga	......	......	......	4	44.0	.88
Punucan	......	......	......	3	36.0	1.05
Sinaba	......	......	......	3	95.0	1.69
Sugmod	......	......	......	1	20.0	1.33

Variety name	1920 Number of stalks harvested	1920 Yield of fiber per 10 hills	1920 Average per cent of fiber per stalk	1921 Number of stalks harvested	1921 Yield of fiber per 10 hills	1921 Average per cent of fiber per stalk
SUCKERS						
Bangulanon	2	85.0	2.02	...	...	...
Canorajan	5	36.0	1.18	1	23.0	1.32
Inosa	8	79.0	1.53	3	48.0	1.11
Itehin-balud	1	10.0	1.00	...	...	...
Itom	7	51.0	.55	4	51.0	.60
Kinosol	...	...	...	...	...	...
Laguis	1	28.0	1.65	...	...	...
Libutanay	6	41.0	1.06	3	40.0	1.57
Libuton	7	41.0	1.37	1	28.0	1.42
Linawaan	1	10.0	.67	1	20.0	.80
Lono	...	...	...	...	...	...
Maguindanao	8	49.0	1.34	1	35.0	1.94
Mininonga	7	38.0	1.32	2	31.0	1.29
Punucan	10	453.0	1.23	2	20.0	.99
Sinaba	4	48.0	2.03	...	25.0	1.73
Sinamoro	...	...	...	...	...	...
ROOTSTOCKS						
Bangulanon	...	...	...	1	90.0	2.14
Canorajan	1	10.0	1.00	...	...	...
Inosa	...	...	...	...	...	...
Itehin-balud	...	...	...	...	...	...
Itom	1	55.0	.81	...	...	...
Kinosol	...	...	...	...	...	...
Laguis	...	...	...	...	...	...
Libutanay	2	54.0	1.12	2	22.0	1.02
Libuton	4	66.0	1.24	3	49.0	1.34
Linawaan	1	80.0	.64	2	20.0	.73
Maguindanao	...	...	...	1	70.0	1.46
Mininonga	7	84.0	1.20	4	75.0	1.22
Punucan	4	52.0	1.19	3	38.0	.89
Sinaba	6	102.0	3.13	3	90.0	1.45
Sugmod	2	41.0	1.19	1	30.0	.19

Variety name	Total average: Number of stalks		Yield of fiber		Percentage of fiber per stalk	
	Total	Average	Total	Average	Total	Average
			Grams	*Grams*		
SUCKERS						
Bangulanon	4	2	155.0	77.5	3.75	1.87
Canorajan	11	4	79.0	26.6	4.04	1.35
Inosa	14	5	258.0	86.0	4.01	1.34
Itehin-balud	12	4	141.0	47.0	3.60	1.20
Itom	22	5	233.0	58.2	3.02	.75
Kinosol	1	1	60.0	60.0	1.08	1.08
Laguis	6	3	63.0	31.5	3.12	1.56
Libutanay	22	5	235.6	58.9	5.68	1.42
Libuton	17	4	256.0	64.0	5.45	1.36
Linawaan	7	2	124.0	31.0	4.02	1.00
Lono	1	1	40.0	40.0	1.67	1.67
Maguindanao	14	5	143.0	47.6	4.71	1.57
Mininonga	20	5	279.0	70.0	5.56	1.39
Punucan	20	5	734.0	183.5	4.89	1.22
Sinaba	17	4	267.0	66.7	7.34	1.83
Sinamoro	7	4	116.3	58.1	2.85	1.42
ROOTSTOCKS						
Bangulanon	1	1	90.0	90.0	2.14	2.14
Canorajan	1	1	10.0	10.0	1.00	1.00
Inosa	...	...	...	...	...	...
Itehin-balud	...	...	...	...	...	...
Itom	1	1	55.0	55.0	.81	.81
Kinosol	...	...	...	...	...	...
Laguis	...	...	...	...	...	...
Libutanay	5	2	121.0	40.3	3.54	1.18
Libuton	8	3	162.0	54.0	3.71	1.23
Linawaan	6	2	153.0	51.0	2.22	.74
Maguindanao	1	1	70.0	70.0	1.46	1.46
Mininonga	15	5	203.0	67.6	3.30	1.10
Punucan	10	3	126.0	42.0	3.13	1.04
Sinaba	12	4	287.0	95.6	6.27	2.09
Sugmod	4	1	91.0	30.3	3.43	1.14

In this test Sugmod did not produce crops when its suckers were used for planting. By using suckers for planting purposes, abacá plants began to produce crops at the age of 2 to 3 years. The average yield of fiber per 10 hills of the different varieties used in 4 years ranged from 26.6 grams to 183.5 grams. Punucan gave the highest yield, while Canorajan gave the lowest. The average percentage of fiber per stalk in 4 years ranged from .75 to 1.87 per cent. Bongolanon (Banbulanon) gave the highest per cent of fiber per stalk while Itom gave the lowest.

By using rootstocks as seed material for planting abacá the plants began to produce crops at the age of 2 to 4 years. Tne average yield in 3 years ranged from 10 grams to 95.6 grams of dry, clean fiber from 10 hills of each of the 17 varieties. Sinaba gave the highest and Canorajan gave the lowest. The average yearly percentage of fiber per stalk in 3 years ranged from .74 to 2.09 per cent, produced by Linawa-an and Sinaba respectively.

The following table shows the results obtained from a comparative test of plants grown from seedlings and fnom suckers:

Variety name	Materials planted	Conditions of plants when stripped	Number of stalks	Weight			Per cent of fiber	Average percentage of fiber per stalk
				Stalks	Fiber wet	Fiber dry		
				Kilos	*Kilos*	*Kilos*		
Maguindanao	suckers	w/ fruits	28	607.8	11.2	8.5	1.40	.05
Do	seeds	do	18	361.2	6.9	5.1	1.41	.08
Do	suckers	w/ o fruits	84	2,074.6	31.8	28.88	1.39	.02
Do	seeds	do	52	143.7	11.0	5.85	0.56	.01
Bangulanon	suckers	w/ fruits	8	59.4	1.5	.58	0.97	.12
Do	seeds	do	4	45.8	1.6	.62	1.35	.33
Do	suckers	w/ o fruits	36	368.9	6.6	4.60	1.24	.03
Do	seeds	do	15	218.8	4.0	1.54	0.70	.05
Sinaba	do	do	50	710.1	10.6	3.60	0.51	.01
Do	do	w/ fruits	1	14.6	.1	.07	0.49	.49
Punucan	suckers	w /o fruits	22	411.9	4.4	2.10	0.57	.02
Do	seeds	do	31	560.4	5.6	2.05	0.37	.01
Do	suckers	w/ fruits	3	36.8	0.2	0.11	0.30	.10
Do	seeds	do	1	6.6	0.2	0.1	1.52	1.52
Pulajan	suckers	w/o fruits	41	478.02	6.1	4.6	0.96	1.02
Do	do	w /fruits	2	25.8	0.3	0.08	0.31	.02
Agutay	suckers	w/o fruits	32	370.2	6.6	2.65	0.72	.02
Do	do	w /fruits	1	6.4	0.2	0.05	0.78	.78
Baguisanon Lawaan	do	w/ o fruits	21	273.4	2.8	1.01	0.37	.02
Lagurhuan Burawen	do	do	48	304.8	2.92	1.08	0.35	1.01
Do	do	w/fruits	4	21.0	0.22	0.17	0.81	.20
Libutanay	do	do	7	64.0	.8	.4	0.62	.09
Do	do	w/o fruits	28	305.2	4.2	1.37	0.45	.02
Do	seeds	do	21	175.2	1.6	0.45	0.26	.01
Lagurhuan Burawen	do	do	37	470.8	3.4	0.62	0.13	.00
Do	do	w /fruits	5	40.2	0.32	0.25	0.62	.12
Tangongon	suckers	w/ o fruits	35	475.8	8.1	5.31	1.12	.30
Do	seeds	do	6	43.4	.4	.15	.35	.064
Ite-hinbalud	do	do	6	85.4	1.0	.30	.35	.06
Do	do	w/ fruits	1	10.2	0.1	.02	.20	.20
Linawaan	do	w /o fruits	16	210.0	2.0	.50	.24	.02
Do	do	w /fruits	5	71.8	0.8	.32	.45	.09
Liahon	do	do	6	69.8	.8	.27	.39	.06
Do	do	w /o fruits	12	161.0	1.8	.52	.32	.03

It was observed that those plants grown from seedlings gave very variable fiber contents. Some hills were found to have no fiber at all, while some gave a high fiber content.

The following table shows the percentage of fiber per stalk of 13 varieties tested:

Variety name	Suckers		Seedlings	
	With fruits per cent fiber per stalk	Without fruits per cent fiber per stalk	With fruits per cent fiber per stalk	Without fruits per cent fiber per stalk
Agutay	.78	.02		
Bangulanon	.12	.03	.33	.05
Baguisanon Lawaan		.02		
Ite-hin-balud			.20	.06
Lagurhuan Burawen	.20	.01	.12	.004
Libutanay	.09	.02		.01
Liahon			.06	.03
Linawaan			.09	.02
Maguindanao	.05	.02	.08	.01
Pulajan	.02	.02		
Punucan	.10	.02	1.52	.10
Sinaba			.49	.01
Tangongon		.03		.06
Total	1.36	.19	2.89	.264
Average	.194	.021	.36	.0264

By using those varieties having yields under all conditions, it was found that with the 13 varieties used the plants grown from seedlings gave a higher percentage of fiber content per stalk than those grown from suckers, and that those with fruits in the suckers and in the seedlings gave a higher percentage per stalk.

FLOWERING EXPERIMENTS

In connection with the variety tests the dates of flowering of different varieties of abacá were observed and recorded to determine how long it takes a variety of abacá stalk to mature, as it is the general belief that flowering is the index of maturity of the stalk of the abacá plants if fiber is to be extracted from it.

This experiment was started in 1916 and stopped in 1921. On June 20–21, 1916, 33 different varieties of abacá were planted in the field, 3 meters between the hills and 3 meters between the rows. Six days previous to planting, holes 40 centimeters square and 50 centimeters deep were dug. The majority of the suckers used were about 2 meters long. The Laguis did not succeed in growing in this field so other plants in another field of the same size as those newly planted were selected for the test. Itom-sport, which was planted on September 26, 1916, was also used.

The dates of flowering of the different varieties were recorded immediately after the flower buds had appeared. The following table shows the number of days it took each variety to flower:

Variety name	Average number of days	Variety name	Average number of days
Agutay	1,130	Lagurhuan Dagami	686
Alman	743	Liahon	745
Baguisanon Basag	951	Libutanay	862
Baguisanon Lawaan	962	Libuton	787
Bangulaon	1,129	Linawaan	1,033
Bisaya	697	Lono	698
Bulao	1,047	Maguindanao	1,074
Canorajan	874	Mininonga	1,010
Ilayas	565	Moro	937
Inosa	950	Pula	850
Itehinbalud	876	Pulajan	1,091
Itom	846	Puti-tomatagacan	984
Kala-ao	515	Sinaba	855
Kinosol	794	Sinamoro	864
Laguis	1,535	Sinamoro Puti	1,036
Lagurhuan Burawen	988	Sugmod	902
		Tangongon	1,219

This table shows that there are early, medium and late maturing varieties of abacá. This confirms the data reported in the Twenty-Second Annual Report of the Bureau of Agriculture, December 31, 1922,(6). The varieties may be grouped as follows: (*a*) Those that flower between the 500th and 800th day are early; (*b*) those between the 801st and 1100th day are medium; and (*c*) those between the 101st and 1400th from transplanting are late varieties.

(*a*) Nine early varieties maturing in from 16.6 to 26.6 months are as follows:

1. Alman
2. Kala-ao
3. Liahon
4. Bisaya
5. Kinosol
6. Libuton
7. Ilayas
8. Lagurhuan Dagami
9. Lono

(*b*) Twenty-one medium maturing varieties, maturing in from 26.7 to 36.6 months are as follows:

1. Baguisanon Basag
2. Canorajan
3. Itom
4. Libutanay
5. Mininoñga
6. Pulajan
7. Sinamoro
8. Baguisanon Lawaan
9. Inosa
10. Itom-sport
11. Linawaan
12. Moro
13. Puti-tomatagacan
14. Sinamoro Puti
15. Bulao
16. Itehinbalud
17. Lagurhuan Burawen
18. Maguindanao
19. Pula
20. Sinaba
21. Sugmod

(*c*) Four late maturing varieties, maturing in from 36.7 to 46.6 months are as follows:

1. Agutay
2. Laguis
3. Bongolanon (Bangulanon)
4. Tangongon

EXTRACTING, BREAKING, AND STRETCHING TEST OF ABACÁ FIBER

The following table shows how each variety stripped, its breaking strain per gran meter, and stretch per 20 centimeters distance.

Variety name	Stripped	Breaking strain per gram meter	Stretch per 20 centimeters distance	Per cent stretch
Agutay	Well	34.45	6.73	3.40
Alman	Poorly	33.19	5.93	3.22
Baguisanon Basag	Well	30.94	4.60	2.33
Baguisanon Lawaan	Well	28.50	4.70	2.37
Bongolanon (Bangulanon)	Well	39.54	7.13	3.58
Bulao	Well	49.96	5.83	2.93
Canorajan	Well	36.06	6.23	3.12
Ilayas	Poorly	46.18	6.23	3.15
Inosa	Poorly	40.34	8.78	4.42
Itom-sport	Poorly	42.27	7.95	4.20
Kala-ao	Very poorly	47.42	5.78	2.90
Lagurhuan Dagami	Poorly	51.21	5.60	2.82
Laguis	Poorly	43.14	6.95	3.49
Layahon (Liahon)	Poorly	48.62	5.58	2.81
Libutanay	Poorly	45.80	7.13	3.59
Lono	Well	35.07	6.88	3.45
Maguindanao	Well	49.51	11.00	5.52
Mininonga	Poorly	34.76	7.10	3.57
Moro	Well	48.91	6.36	3.26
Pula	Well	46.12	8.18	4.12
Pulajan	Well	48.48	5.33	2.89
Punucan	Well	37.73	5.85	2.96
Puti-tomatagacan	Well	51.89	6.23	3.16
Sinaba	Well	42.51	7.88	3.95
Sinamoro	Fairly	34.77	5.70	2.87
Sinamoro-Puti	Well	47.57	7.25	3.65
Tangongon	Well	43.21	6.78	6.41
Bisaya	Well	33.26	5.83	2.95

From these data it is evident that Tangongon and Maguindanao have the strongest fibers.

PLANT SELECTION TESTS

Not much work was done on this test. The suckers for planting were selected from the best hills. The selected plants showed better stands and better growth in the field observations than the unselected.

HYBRIDIZATION WORK

Hybridization work on abacá was started in July, 1920, with the following materials:

Kala-ao—♂—X Punucan—♀.
Libuton—♂—X Itom—♀.
Canorajan—♂—X Lagurhuan Burawen—♀.

No good seeds have been obtained from these crosses. The work is being continued with the following materials:

Tangongon—♂—X Bangulanon—♀.
Bongolanon (Bangulanon)—♂—X Maguindanao—♀—
Maguindanao—♂—X Tangongon—♀—

GROWING OF ABACÁ SEEDLINGS

There are several abacá seedlings now ready for further studies. They came from 22 different varieties of abacá at this station. Each hill of these unknown varieties will be tested as to fiber content and per cent of fiber per stalk to determine if the seedlings are really hybrids or not. Those that are found to be good will be grown on a large scale and distributed to farmers.

CULTURAL TREATMENT OF ABACÁ PLANTS

Plowing and harrowing were done in the abacá field cultures and hoeing around the plants to free them from weeds and the dried leaves and stalks at the base of the stalks of the plants were removed in the different fields as soon as the soil got weedy. This method is too expensive, however. Planting cover crops, such as camotes or sweet potatoes, Lyon beans, or cowpeas between the rows of abacá, has proved to be very beneficial and cheaper. This is best done when the abacá plants are still young.

PESTS AND DISEASES

Pests.—The larvae of small and large beetles are found attacking the bases of abacá stalks. They make large holes in the stalks of the abacá plants and then the leaves turn yellow. The pests are more abundant during the dry season, particularly in November and December.

General sanitation, that is destroying all the breeding places of the insects, has proved good.

Diseases.—Abacá heart rot has been found attacking the abacá plants. It is more prevalent during the wet seasons.

Burning the diseased plants reduced the attack of the disease.

The following table shows our observations of the different varieties:

Variety name	Date Observed					
	May 10, 1923		September 13,1923		April 4, 1924	
	Suckers per cent diseases	Seedlings per cent diseases	Suckers per cent diseases	Seedlings per cent diseases	Suckers per cent diseases	Seedlings per cent diseases
Agutay	.5	0	0	.6	.6	0
Alman	......	......	......	......	.6	1.0
Anono	......	......	......	......	......	......
Baguisanon Basag	......	......	......	......	1.2	......
Baguisanon Lawaan	6.2	8.0	3.0	0	4.18	3.8
Bongolanon (Bangulanon)	......	......	5.9	.6	.6	1.8
Bisaya	5.0	2.0	0	0	2.6	1.8
Canorajan	0	......	......	......	......	......
Ilayas	.5	1.0	.3	.6	4.6	2.7
Itehin-balud	......	......	0	0	3.0	.6
Itom	2.0	1.0	.3	0	3.6	.6
Kala-ao	1.5	1.5	.6	.6	.16	1.8

Variety name	Date Observed					
	May 10, 1923		September 13,1923		April 4, 1924	
	Suckers per cent diseases	Seedlings per cent diseases	Suckers per cent diseases	Seedlings per cent diseases	Suckers per cent diseases	Seedlings per cent diseases
Kinosol	0	0	0	0	.6	.6
Lagurhuan Burawen	6.0	12.5	3.6	.6	0	....
Layahon (Liahon)	1.0	0	0	0	2.4	0
Libutanay	2.0	1.5	.6	0	2.4	0
Linawaan	0	0	.6	1.2	2.4	.6
Lono	4.0	1.0	0	1.8	3.6	1.2
Maguindanao	4.0	1.0	4.1	3.9	2.4	11.6
Moro	1.5	0	0	0	0	0
Pulajan	2.0	0	3.1	.0	1.2	6.6
Punucan	6.0	1.0	1.2	1.8	3.0	0
Sinaba	5.0	.5	2.4	.6	1.2	0
Sinamoro Puti	2.0	.5	0	.6	1.8	0
Sugmod	0	0	0	0	.6	.6
Tabono	0	....	....	....	0	....
Tangongon	1.0	0	3.0	1.2	.6	1.2
Total	50.2	31.5	28.7	14.1	43.3	36.5
Average	2.9	2.6	2.2	1.2	2.0	2.4

From the data obtained, it is evident that plants grown from seedlings are more resistant than those grown from suckers.

The writer wishes to acknowledge his indebtedness to Mr. Silvestre Asuncion, formerly Assistant Sugar Technologist, In charge, Sugar-Cane Investigation, La Carlota Experiment Station, La Carlota, Occidental Negros, for his valuable criticism and suggestions during the preparation of this manuscript.

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EXPERIMENTS ON UPLAND RICE AT LA CARLOTA AND ALABANG RICE EXPERIMENT STATIONS FROM 1916 TO 1926

At La Carlota Experiment Station, La Carlota, Occidental Negros, a variety test of upland rice was conducted in 1916. Very good results were obtained because conditions were all good. Four of the varieties tested yielded more than 3,000 kilos per hectare while 12 of them yielded between 2,500 and 3,000 kilos per hectare.

Table I shows the results of the experiment.

TABLE I.—*Variety test of upland rice at La Carlota Experiment Station for the year 1916*

Plot number	Permanent number	Name	Age at maturity	Yield per hectare in kilos
1	966	Daliket or Sanglay	122	3,330
2	1050	Kinastila V	122	2,345
3	1051	Nagdami II	137	3,250
4	967	Binundok II	143	2,570
5	971	Kinastaño	137	2,750
6	943	Bonguet	137	2,850
7	791	Sanglay Puti	125	2,455
8	951	Kalibod	143	2,633
9	724	Putyucanon	143	2,270
10	78	Binagontauo	152	1,458
11	574	Maliro	152	1,308
12	774	Sacsek	155	2,645
13	969	Binucaue	143	2,100
14	815	Sinacoban	153	2,820
15	92	Binicol I	153	2,108
16	619	Manteca Pilit	152	2,245
17	945	Catalong	154	2,820
18	126	Bulandi	154	2,158
19	956	Inantipolo II	143	2,445
20	936	Inanod	153	1,770
21	983	Bulunan	113	3,050
22	988	Quinabebe II	113	2,450
23	47	Barangcal	145	2,470
24	987	Magdalena	144	1,770
25	980	Kinastila IV	132	2,910
26	998	Macarañag II	144	2,383
27	363	Dinagat II	132	2,150
28	999	Hinirang	143	2,745
29	1006	Palongpong	153	1,920
30	379	Eput-Ebun	[a]	[a]
31	1061	Bangoi or Saigorot	[b]	[b]
32	1062	Bebe	136	2,500
33	1068	Bulao IV	118	2,470
34	1069	Bulastog or Ortoc	[a]	[a]
35	1073	Calibug	142	1,570
36	1089	Diquet a Pinasagad	151	1,055
37	1095	Guinarana	157	520
38	1048	Inintiw	123	1,420
39	1097	Init-log dalag	135	2,150
40	1100	Lampadan or Allañgigan	141	1,445
41	1101	Langauisan	142	1,720

[a] Abandoned for being too late. [b] Failed to germinate.

TABLE I.—*Variety test of upland rice at La Carlota Experiment Station for the year 1916*—Continued

Plot number	Permanent number	Name	Age at maturity	Yield per hectare in kilos
42	1103	Lubang Blanco	142	1,738
43	1049	Macan II	130	2,413
44	1110	Mangasa	142	1,695
45	1111	Mayoro II	153	1,670
46	1117	Minantica IV	143	2,420
47	1125	Pinili a Biit	(c)	(c)
48	1133	Samban	130	3,250
49	1138	Sinampaga	151	2,620
50	1132	Salomanay	(b)	(b)
51	1136	Sinaba III	150	1,430
52	1137	Sinaba (Pinili)	(b)	(b)
53	New.	Casulig	151	2,120
54	New.	Cayangcang	151	2,070
55	New.	Cutsiam	130	1,950
56	New.	Daliquet	128	2,585
57	New.	Pinalengke	149	1,320
58	New.	Tuhao or Caot	151	1,220

[b] Failed to germinate. [c] Only few grains germinated.

Seven of the varieties which made a poor showing in the 1916 test at La Carlota were discarded, and 20 new varieties tried in 1917, making a total of 71 varieties for the 1917 variety test. Of the earliest varieties found, 14 matured in from 116½ to 132 days from the date of sowing. The varieties Daliket or Sanglay (966), Sanglay Puti (781), Kinastila IV (980), and Initlog Dalag (1097) gave high yields—from 2,767.5 to 3,185 kilos—per hectare. Two varieties were found to yield more than 3,000 kilos and 15 varieties less than 3,000 kilos but above 2,500 kilos per hectare.

All plots were damaged more or less by rats, "atangias," and birds. During the year there were strong winds and too much rain.

Table II shows the results of the experiment.

TABLE II.—*Variety test of upland rice at La Carlota Experiment Station for the year 1917*

Plot number	Permanent number	Name	Age at maturity	Yield per hectare in kilos
1	New.	Macatibos	116.5	2,445
2	983	Buluhan	116.5	2,650
3	1068	Bulao IV	121.0	2,353
4	966	Daliket or Sanglay	126.0	2,785
5	1050	Kinastila V	127.0	2,607.5
6	1048	Inintiw	125.5	1,570
7	791	Sanglay Puti	129.0	2,830
8	......	Cotchiam	127.0	2,351
9	1049	Macan II	129.0	2,230
10	1133	Samban	127.0	2,610
11	363	Dinagat II	131.5	2,305

TABLE II.—*Variety test of upland rice at La Carlota Experiment Station for the year 1917*—Continued

Plot number	Permanent number	Name	Age at maturity	Yield per hectare in kilos
12	980	Kinastila IV	129.0	2,767.5
13	1097	Initlog dalag	132.0	3,185
14	1062	Bebe	143.0	2,925
15	943	Bonguet	139.0	2,275
16	971	Kinastaño II	137.0	2,552.5
17	1051	Nagdami II	137.0	2,590
18	1100	Lampadan or Allangigan	140.0	1,922.5
19	1073	Calibug	142.0	2,385
20	1101	Langauisan	137.0	1,950
21	1103	Lubang Blanco	144.0	2,737.5
22	1110	Mangasa II	142.0	3,270
23	724	Putyucanon	144.0	2,172.5
24	969	Binucaue	144.0	1,852.5
25	956	Inantipolo II	144.0	2,625
26	999	Hinirang	146.5	2,422.5
27	967	Binundoc II	147.0	2,332.5
28	951	Kalibod	142.0	2,670
29	1117	Minantica IV	146.5	2,252.5
30	987	Magdalena	141.0	2,530
31	998	Macarañag II	146.5	2,212.5
32	47	Barangcal	137.5	2,795
33	......	Pinalenke	149.0	1,745
34	1136	Sinaba III	148.5	1,805
35	......	Casulig	148.5	1,815
36	970	Cayangcang	148.5	1,450
37	1089	Diquet a Pinasagad	151.5	1,117.5
38	1138	Sinampaga	148.5	1,740
39	......	Tuhao or Caot	150.5	2,570
40	619	Minantica Pilit	148.0	2,292.5
41	78	Binagontauo	149.5	1,700
42	574	Maliro	139.0	1,897.5
43	936	Inanod I	152.0	1,967.5
44	1006	Palongpong	153.5	1,792.5
45	1111	Mayoro II	152.0	1,920.5
46	815	Sinacoban	152.0	1,677.5
47	92	Binicol I	149.5	2,330
48	945	Catalong	152.0	2,890
49	126	Bulandi	152.0	2,440
50	74	Sacsek	149.5	2,272.5
51	1095	Guinarana	167.5	2,005
52	1125	Pinili a biit	143.5	1,807.5
53	362	Dinagat I	126.5	2,322.5
54	1164	Inachupal	[a]	[a]
55	1166	Kinandang Kumpol	149.5	2,157.5
56	1180	Piniling Beltu	[a]	[a]
57	1181	Pol-lique	149.5	2,130
58	1184	Ugnas	149.5	2,095
59	......	Menita	151.5	2,360
60	......	Pulupot	149.5	1,937.5
61	1160	Cucuam	149.5	1,360
62	1161	Dinalaga	138.0	1,900
63	1165	Kinalabao a Purao	[a]	[a]
64	1171	Lacatan Lihim	[a]	[a]
65	1176	Malagket Sinablay	[a]	[a]
66	1179	Piniling	152.0	1,475
67	1151	Bansuray	182.0	672
68	1152	Bangol	151.5	987.5
69	1153	Balolaki	182.0	922.5
70	1157	Bulik	176.0	1,232.5
71	1178	Piatan	151.5	2,065

[a] Not harvested.

In 1918 the test was repeated. A number of the varieties that were tested came from the Alabang Rice Experiment Station where they were found to behave differently under irrigated culture.

In Table III are listed the 80 varieties which were tested, with their respective performances.

TABLE III.—*Variety test of upland rice at La Carlota Experiment Station for the year 1918*

Plot number	Permanent number	Name of variety	Age at maturity	Yield per hectare in kilos
1	1190	Miyako II	109.5	322.5
2	1188	Sekitori	132.5	120.0
3	1189	Takenari	136.5	67.5
4	958	Macatibos	120.5	1,445.0
5	983	Buluhan	124.5	1,770.0
6	1068	Bulao IV	127.5	1,597.5
7	966	Daliket or Sanglay	129.0	1,895.0
8	1050	Kinastila V	130.5	1,670.0
9	1048	Inintiw	130.5	2,070.0
10	791	Sanglay Puti	134.5	1,245.0
11	1147	Cutsiam II	132.5	1,420.0
12	1049	Macan II	132.5	1,870.0
13	1133	Samban	132.5	1,745.0
14	362	Dinagat I	130.5	1,870.0
15	1150	Balasang	141.5	1,320.0
16	979	Magpunit II	136.5	1,645.0
17	991	Malagkit Kaawa	142.5	1,120.0
18	363	Dinagat II	136.5	1,670.0
19	980	Kinastila IV	133.5	1,295.0
20	1097	Initlog dalag	133.5	1,170.0
21	1193	Kinastila VII	132.5	1,570.0
22	1062	Bebe	139.5	1,470.0
23	943	Bonguet	137.5	870.0
24	971	Kinastaño	139.5	1,370.0
25	1051	Nagdami II	138.5	1,295.0
26	1100	Lampadan or Allañgigan	138.5	1,370.0
27	1158	Cammang	142.5	1,445.0
28	1001	Apostol	159.0	2,295.0
29	1161	Dinalaga	136.5	1,645.0
30	1073	Calibug	139.5	1,520.0
31	1101	Langauisan	140.5	1,370.0
32	1103	Lubang Blanco	139.5	1,670.0
33	1110	Mangasa	137.5	1,495.0
34	724	Putyucanon	138.5	1,345.0
35	969	Binucaue	140.0	1,120.0
36	956	Inantipolo II	140.5	1,120.0
37	1149	Bagsang	144.5	745.0
38	999	Hinirang	146.5	1,170.0
39	967	Binundok II	144.5	1,220.0
40	951	Kalibod	140.5	1,245.0
41	1117	Minantica IV	143.5	1,120.0
42	987	Magdalena	138.5	1,570.0
43	998	Macarañag II	143.5	1,195.0
44	47	Barangcal	136.5	1,770.0
45	961	Pinalenke	144.5	920.0
46	1136	Sinaba III	143.5	895.0
47	1146	Casulig	142.5	770.0
48	970	Cayangcang	141.5	1,145.0
49	1089	Diquet a Pinasagad	147.5	920.0
50	1138	Sinampaga	142.5	1,070.0
51	1148	Tuhao or Caot	144.5	1,420.0
52	619	Minantica Pilit	143.5	1,620.0
53	78	Binagontauo	143.5	1,820.0
54	574	Maliro	140.5	1,970.0
55	936	Inanod	146.5	1,270.0
56	1006	Palongpong	149.5	1,695.0
57	1111	Mayoro II	148.5	1,670.0
58	815	Sinacoban	147.5	1,520.0
59	92	Binicol L	143.5	1,620.0
60	945	Catalong	147.5	1,570.0
61	126	Bulandi	148.5	1,545.0
62	774	Sacsek	144.5	1,570.0
63	1125	Pinili a Biit	140.5	1,495.0
64	1166	Kinandang Kumpol	144.5	1,520.0
65	1181	Pol-lique	143.5	1,245.0
66	1184	Ugnas	144.5	1,020.0
67	1185	Menita	146.5	1,420.0
68	718	Pulupot	143.5	1,120.0
69	1160	Cucuam	143.5	1,170.0
70	1179	Piniling	145.5	920.0
71	1152	Bangol	146.5	620.0
72	1178	Piatan	146.5	970.0
73	1231	Nagoyon	141.5	1,120.0
74	1226	Mangara	141.0	1,170.0
75	1234	Piniling Bebay	147.5	1,270.0
76	1230	Naglihim	144.5	1,970.0

TABLE III.—*Variety test of upland rice at La Carlota Experiment Station for the year 1918*—Continued

Plot number	Permanent number	Name of variety	Age at maturity	Yield per hectare in kilos
77	1215	J. Rice (No name)	136.5	42.5
78	1217	Kinandang Puti	134.5	1,745.0
79	1216	Kinandang Pula	138.0	1,470.0
80	1218	Inagsaya	141.5	1,465.7

GENERAL VARIETY TEST

In the general variety test of upland rice at La Carlota Experiment Station for the year 1919, the 80 varieties of upland rice which were subsequently used were planted June 23 and 24, 1919. Harvesting was done during the months of October and November. All the varieties, except two which came from Japan and two from China, made a good showing from the start. Despite the storm which occurred during the middle part of October when most of the varieties were in head and some maturing, the native varieties gave better results than in 1918.

The following table shows some of the important characters and performances of the varieties tried. It must be understood that losses as indicated in the corresponding column are not included in the computation of yield. Yields were computed from the actual amount harvested from the plots.

TABLE IV.—*General variety test of upland rice at La Carlota Experiment Station for the year 1919*

	Permanent number	Variety name	Average height	Age at heading	Age at maturity	Uniformity at maturity	Computed yield per hectare	Maximum estimate for losses in the production due to—	
								Undeveloped heads due to atangia, and other insects	Grains shattered off by the storm
			Cm.	*Days*	*Days*		*Kilos*	*Per cent*	*Per cent*
1	1190	Miyako II	62.60	61.0	88.0	([c])	598.90	......	......
2	188	Sekitori	90.60	70.0	98.5	([d])	1,155.00	......	......
3	......	Chinese first crop Glutinous Rice	64.17	63.0	95.0	([c])	562.66	......	......
4	......	Chinese Autumn crop Glutinous Rice	61.30	61.0	95.0	([c])	721.30	......	......
5	......	Macatibos	118.80	77.5	88.0	([e])	2,856.75	......	......
6	983	Buluhan	89.65	67.0	93.5	([e])	3,067.25	......	......
7	1068	Bulao IV	126.00	78.5	105.5	([e])	2,754.50	......	......
8	966	Daliket or Sanglay	118.10	81.5	106.0	([c])	3,476.25	......	7
9	1050	Kinastila V	113.70	85.5	110.5	([e])	2,089.50	......	30
10	1048	Inintiw	117.20	78.5	105.0	([e])	2,833.50	......	20
11	791	Sanglay Puti	113.50	87.5	108.5	([e])	2,150.20	......	10
12	......	Cutsiam	116.30	90.5	111.0	([e])	2,163.30	......	10
13	1049	Macan II	113.65	82.0	106.5	([e])	3,155.70	......	10
14	1133	Sampan	115.80	87.5	105.0	([e])	2,016.50	......	30
15	362	Dinagat I	111.40	82.0	107.5	([e])	1,907.70	......	30

[c] Not uniform. [d] Medium. [e] Very uniform.

TABLE IV.—*General variety test of upland rice at La Carlota Experiment Station for the year 1919*—Continued

	Permanent number	Variety name	Average height	Age at heading	Age at maturity	Uniformity at maturity	Computed yield per hectare	Maximum estimate for losses in the production due to—	
								Undeveloped heads due to atangia, and other insects	Grains shattered off by the storm
			Cm.	*Days*	*Days*		*Kilos*	*Per cent*	*Per cent*
16	1150	Balasang	117.60	90.5	113.0	(e)	2,234.10		2
17	979	Magpunit II	111.60	87.5	107.5	(d)	2,123.50	1	7
18	......	Malagkit Kaawa	108.70	88.5	120.0	(d)	1,694.72	....	10
19	363	Dinagat II	115.70	85.0	109.0	(d)	2,129.95	....	20
20	980	Kinastila IV	110.80	93.0	113.5	(e)	2,241.40	....	30
21	1097	Initlog dalag	129.30	92.0	123.5	(e)	2,252.81	3	5
22	1193	Kinastila VII	119.20	87.5	109.0	(e)	2,583.57	....	30
23	1062	Bebe	113.20	97.5	119.5	(d)	2,264.50	3	....
24	943	Bonguet	123.10	95.5	118.5	(e)	2,191.23	3	....
25	971	Kinastaño	121.90	96.5	118.5	(e)	2,127.65	3	....
26	1051	Nagdami II	125.20	97.0	118.5	(e)	1,994.53	1	....
27	1100	Lampadan or Allangigan	118.90	88.5	117.5	(e)	1,931.00	1	....
28	1158	Cammang	118.20	88.5	117.0	(e)	2,049.83	1	....
29	1001	Apostol	78.00	117.5	145.0	(e)	2,454.52		....
30	1161	Dinalaga V	111.70	95.5	114.5	(e)	1,892.70	1	5
31	1073	Calibug	127.69	96.5	121.5	(d)	2,533.40	1	....
32	1101	Langauisan	129.90	95.5	119.5	(e)	2,576.86	....	10
33	1103	Lubang Blanco	112.62	94.5	120.5	(e)	3,241.00	....	5
34	1110	Mangasa II	113.40	95.5	122.0	(e)	3,155.50	....	5
35	724	Putyucanon	136.90	94.5	121.5	(e)	1,876.33	....	5
36	969	Binucaue	129.90	95.5	121.0	(d)	1,986.15	1	....
37	956	Inantipolo II	112.10	109.5	121.5	(d)	1,610.77	3	....
38	1149	Bagsang	133.50	94.5	136.5	(e)	1,747.85	3	....
39	999	Hinirang	116.00	100.5	127.0	(f)	2,744.92	1	....
40	967	Binundoc II	113.50	95.5	127.0	(f)	2,118.47	1	....
41	951	Kalibod	127.50	97.5	115.5	(d)	2,221.10	1	....
42	1117	Minantica IV	110.20	100.5	117.0	(e)	1,804.82	2	....
43	987	Magdalena	105.20	96.0	121.5	(e)	2,062.50	3	....
44	998	Macarañag II	108.20	96.5	119.5	(d)	1,968.97	....	....
45	47	Barancal	109.20	95.0	119.5	(d)	2,296.35	....	5
46	......	Pinalenke	117.20	119.5	125.5	(e)	1,901.20	....	....
47	1136	Sinaba III	120.90	87.5	116.5	(e)	2,258.64	....	....
48	......	Casulig	114.50	102.5	121.0	(e)	1,877.17	....	....
49	......	Cayangkang	105.20	102.5	122.5	(e)	1,578.79	3	....
50	1089	Diquet a Pinasagad	111.40	102.5	130.5	(e)	2,256.91	2	....
51	1138	Sinampaga	112.10	100.0	120.5	(e)	1,254.07	3	5
52	......	Tuhao or Caot	109.70	108.5	128.5	(e)	2,037.11	2	....
53	619	Minantica Pilit	120.60	104.0	129.0	(d)	1,651.41	3	....
54	78	Binaguntauo	119.50	103.0	126.5	(e)	1,477.54	3	5
55	574	Maliro	124.20	104.0	120.5	(e)	1,581.80	3	....
56	936	Inanod I	115.60	106.0	118.5	(d)	1,490.64	3	....
57	1006	Palongpong	109.70	115.5	138.0	(e)	1,979.25	....	....
58	1111	Mayoro II	120.20	112.0	131.5	(e)	2,198.62	....	....
59	815	Sinacoban	128.30	109.0	128.0	(e)	2,048.00	....	....
60	92	Binicol I	121.60	101.5	123.0	(e)	2,268.50	1	....
61	945	Catalong	106.40	110.0	131.0	(e)	1,889.10	....	....
62	126	Bulandi	101.10	110.0	131.0	(e)	1,520.01	....	....
63	774	Sacsek	114.30	109.0	117.5	(e)	1,923.84	....	....
64	1125	Pinili a Biit	123.30	99.0	116.0	(e)	2,433.88	1	....
65	1166	Kinandang Kumpol	114.40	100.0	121.0	(e)	1,931.30	3	....
66	1181	Pol-lique	133.60	97.0	117.0	(d)	2,069.30	1	5
67	1184	Ugnas	133.90	98.5	118.0	(d)	2,037.15	1	5
68	......	Menita	110.60	111.5	131.5	(d)	1,547.00	1	....
69	......	Pulupot	112.00	102.5	120.0	(d)	1,698.50	3	....
70	1160	Cucuam	111.80	102.5	121.0	(e)	1,240.99	3	5
71	1179	Piniling	105.80	102.5	119.0	(e)	1,306.50	3	....
72	1152	Bangol	117.20	102.5	122.5	(d)	1,901.71	3	....
73	1178	Piatan	145.10	100.5	124.0	(e)	2,112.80	3	....
74	1231	Nagoyon	122.50	100.5	119.0	(d)	1,992.44	3	3
75	1226	Mangara	115.90	100.5	121.0	(e)	1,804.42	3	....
76	1234	Piniling Bebay	104.10	107.0	129.5	(e)	1,503.12	3	....
77	1230	Maglihim	99.50	113.5	137.5	(e)	2,812.38	....	10
78	1217	Kinandang Puti	117.40	95.5	114.5	(e)	3,136.92	....	5
79	1216	Kinandang Pula	116.70	95.5	114.0	(e)	3,185.47	3	....
80	1213	Inagsaya	112.90	105.0	122.5	(e)	1,976.50	....	....

[d] Medium. [e] Very uniform. [f] Fairly uniform.

MONTHLY VARIETY TEST

The monthly variety test was a series of monthly plantings ending in January 1920. Twelve varieties were used throughout. The seed was planted in drills, three rows of each variety 10 meters long 50 centimeters apart. From time to time cultivation was done.

The first planting was started September 20; the second, October 24; and the third November 24, 1919. In the first planting only 11 varieties were used instead of 12 as stated previously. Since the Macatibos made a good showing in the general variety test of 1919 it was included in the second planting. Twelve varieties were used in the third planting.

The following varieties were used in the tests: 1001 Apostol, 78 Binagontauo, 1068 Bulao IV, 983 Buluhan, 966 Daliket or Sanglay, 362 Dinagat I, 956 Inantipolo II, 1048 Inintiw, 1049 Macan II, Macatibos, 1230 Naglihim, 574 Maliro.

The seeds used in the first planting were old ones. The amount of seeds used for each variety varied from 150 grams to 260 grams. Some of the varieties did not show good germination. The seeds were gradually losing their vitality. In the second planting old seeds were again used except for the varieties Inantipolo II and Macatibos. The amount of seeds used in the case of the old ones varied from 200 grams to 510 grams; and for the Inantipolo II and Macatibos, 140 grams. As will be noted here, the amount of old seeds used in the second planting was more than that of the first because the seeds were rapidly losing their vitality. In the third planting all the seeds used were new. Each variety was allowed 150 grams of seeds. The plants did not grow as high as those raised in the regular rice season and were less productive. Those in the first culture were generally about 50 centimeters high.

An atempt to improve upland rice by selection was made at Alabang Rice Experiment Station in 1919. It consisted in planting grain from single heads to one row and in depositing threshed grain, where heads were not procurable, separately in the hills and thinning out afterwards, the distance between hills in both cases being a uniform 20 centimeters.

Twelve rows of Apostol (1001) and 15 rows of Inantipolo (956), were planted from heads obtained from La Carlota Experiment Station; also, 8 rows of Kinastila IV (980), with seed obtained from Los Baños Agricultural Colege, 8 rows of Cruz (1003) and 8 rows of Mangasa (1110), both stocked with Alabang grown seed.

The whole was sown May 17. The Inantipolo was harvested in 152 days, the Kinastila IV in 131 days, Mangasa in 130 days, Cruz in 169 days and the Apostol in 186 days. Just as in palagad planting, the early planting of Cruz and Apostol did not insure early maturity. Vegetative growth, elastic-like, staggered on through the months of July, August and September and only in October did they set any flowers. The Cruz did not give anything comparable with its yield in the paddy field; the Apostol produced a respectable crop; the Kinastila IV did not thrive; the Mangasa had many heads but small; the Inantipolo had a good many strong bunch of stalks, but the heads did not mature uniformly, and the stand was poor.

But this experiment was not concerned so much with finding the real yielding capacity of these different varieties, as with the isolation of any individual plant that might be found worthy of trial in the head-to-the-row test. Accordingly 7 plants of Kinastila and 4 plants of Inantipolo were selected; and 1 plant of Kinampupoy, and 3 unknown plants isolated.

In 1920 general variety, head-to-the-row, and monthly variety tests, and observations on the viability of the different varieties of upland rice were carried on at La Carlota. The main object of the general variety test was the study of the most important characters of the different varieties for the determination of good and poor yielders and their resistance to insect attacks, while in the head-to-the-row test the isolation of high yielding strains within a high yielding variety, and in the monthly variety test the study of the possibility of growing upland rice during the latter part of the rainy season, were the aims. In the viability tests, rice placed in sacks was observed.

GENERAL VARIETY TEST

Out of the 203 varieties which were planted June 12–16, inclusive, and June 23 to July 2, inclusive, only 177 varieties were harvested because 8 varieties did not germinate while the rest did not grow well. All varieties had been harvested during the months of September, October, and November excepting the two Siamese varieties and one native variety. Eighty-eight varieties had been cultured at La Carlota Experiment Station for at least one year; the rest were newly introduced. All varieties were native, with the exception of two varieties introduced from America, 2 from China, 4 from Japan, and 5 from Siam. All varieties made a good showing at the start but due to the bad weather during the month of September, lack of rain

during the last week of October, and a storm which occurred November 3–4 and the fungus and insect attacks the crops in 1920 were not so good as was expected.

Table V shows the individual performance of each variety including its height and age at maturity. It must be understood that yields were computed from the actual amount harvested from the plots excluding losses as indicated in the column for remarks and those affected by the non-uniformity of the land.

TABLE V.—*Variety test of upland rice at La Carlota Experiment Station for the year 1920*

Permanent No.	Variety name	Height of plants at maturity	Age of plants at maturity	Yield per hectare	General remarks (1920) [e]
		Cm.	*Days*	*Kilos*	
1190	Miyako II	53.89	89.00	687.50	[a] Fair; [b] 3 per cent.
1188	Sekitori	83.66	91.00	1,105.00	[a] Very good; [b] 2 per cent.
1189	Takenari	80.38	118.50	730.00	[a] Good; [b] 5 per cent; [d] A to October 23; B to October 22, 1920.
1215	Japanese Rice (No name)	36.26	91.25	72.50	[a] Fair.
1280	Chinese (1st crop) Glutinous rice	50.34	94.75	1,500.00	[a] Fair.
1281	Chinese Autumn crop	45.92	94.25	292.00	[a] Fair.
1246	Siamese Rice	76.00	152.50	992.50	[a] Fairly good; [b] 2 per cent: [c] October 20 to November 7; [d] November 6 to 20, 1920.
1247	Khao Bai Sri	80.46	141.50	1,050.00	[a] Very good; [c] October 7–25; [d] October 28 to November 10, 1920.
1248	Kathisod	70.96	154.00	470.00	[a] Fair. [c] A October 20 to November 5. B October 2 to November 6; [d] November 8 to November 30.
1249	Nan Lerng	75.00	170.75		[a] Fairly good; [b] 2 per cent [c] A November 14–29; B November 15–28. [d] A November 23 to December 11. B November 30 to December 13.
1250	Thul Chalong	68.00	170.75		[a] Fair; [b] 60 per cent; [c] [d] same as above.
983	Buluhan	74.29	98.50	1,127.50	[a] Very good.
958	Macatibos I	83.75	98.75	967.50	[a] Good; [b] 1 per cent.
1068	Bulao IV	88.69	106.75	870.00	[a] Fairly good; [b] 3 per cent.
966	Daliket or Sanglay	78.43	114.00	1,245.00	[a] Good; [b] 2 per cent [d] A to October 5; B to October 10.
1048	Inintiw	76.86	114.00	1,337.50	[a] Very good; [b] 7 per cent; [d] September 27 to October 15.
791	Sanglay Puti	73.38	116.50	1,227.50	[a] Very good; [b] 4 per cent; [d] A to October 19; B October 20.
1049	Macan II	86.59	114.50	1,260.00	[a] Very good; [b] 7 per cent; [d] A October 16; B October 15.
1133	Samban	85.53	117.75	1,300.00	[a] Good; [b] 1 per cent; [d] A October 14. B October 15.
362	Dinagat I	75.49	116.50	820.00	[a] Good; [b] 8 per cent; [d] A October 20; B October 19.
979	Magpunit II	82.93	126.50	1,012.50	[a] Good; [d] A and B October 8–27.
363	Dinagat II	74.99	111.50	622.50	[a] Fairly good; [b] 1 per cent; [d] A October 12; B to October 15.
1050	Kinastila V	76.82	114.50	1,045.00	[a] Good; [b] 1 per cent; [d] A October 16; B October 15.
1147	Cutsiam II	80.46	115.50	882.50	[a] Fairly good; [b] 1 per cent; [d] A October 18; B to October 16.
1150	Balasang	86.64	117.50	1,392.50	[a] Very good; [b] 1 per cent; [d] A and B to October 20.

[a] General condition of crop.
[b] Per cent destroyed by rats, birds, insect, and fungus attack, etc.
[c] Date headed.
[d] Date matured.
[e] Continuation of September, 1920, Report.

TABLE V.—*Variety test of upland rice at La Carlota Experiment Station for the year 1920*—Continued

Permanent No.	Variety name	Height of plants at maturity	Age of plants at maturity	Yield per hectare	General remarks (1920) [e]
		Cm.	*Days*	*Kilos*	
990	Ka-awa	76.45	110.50	787.50	[a] Fairly good; [b] 1 per cent; [d] A October 15; B October 16.
980	Kinastila IV	80.85	113.50	1,277.50	[a] Very good; [d] A and B September 27 to October 14.
1564	Malagkit	77.03	126.00	565.00	[a] Fair; [d] A and B October 9–25.
1097	Initlog dalag	89.06	125.50	682.50	[a] Fairly good; [b] 1½ per cent; [d] A and B October 8–25.
1193	Kinastila VII	82.34	111.50	870.00	[a] Good; [d] A October 7 and B October 6.
1216	Kinandang Pula	80.37	115.00	812.50	[a] Fairly good; [b] 1 per cent; [d] A October 10 and B October 13.
1062	Bebe	88.46	123.75	1,050.00	[a] Good; [b] 1 per cent; [c] A October 7 and B October 4; [d] A October 8–26, B October 6–24.
1217	Kinandang Puti	88.44	113.50	1,387.50	[a] Very good, [d] A October 7, B October 13.
943	Bonguet	88.28	115.25	682.50	[a] Poor; [c] to October 1; [d] A October 7–20; B October 8–22.
971	Kinastaño	85.57	119.24	945.00	[a] Very good; [b] 1 per cent; [c] B October 1; [d] A October 8–22; B October 10–23.
1051	Nagdami II	86.35	122.00	767.50	[a] Very good; [b] 1 per cent; [d] A October 6–20; B October 7–21.
1100	Lampadan or Allañgigan	93.23	114.00	1,000.00	[a] Fairly good; [b] 1 per cent; [d] A October 15; B to October 14.
1158	Cammang	94.72	114.50	940.00	[a] Good; [d] A October 17; B October 16.
1161	Dinalaga	90.55	118.50	1,001.50	[a] Good; [b] 1 per cent; [d] A and B September 27 to October 16.
951	Kalibod	96.49	127.00	1,380.00	[a] Very good; [b] 1 per cent; [c] A October 1; B October 2; [d] October 8–27.
1117	Minantica IV	83.19	127.00	1,175.00	[a] Good; [b] 1 per cent; [c] A and B October 1; [d] October 8–27.
998	Macarañag II	90.06	124.50	1,420.00	[a] Very good; [b] 1 per cent; [c] do.; [d] October 12–28.
47	Barancal	86.08	125.75	405.00	[a] Fairly good; [b] 1 per cent; [d] A October 8–27; B October 7 to 27.
1136	Sinaba III	93.20	120.75	867.50	[a] Fairly good; [b] 1 per cent; [d] A October 26; B October 25.
574	Maliro	92.72	125.50	1,260.00	[a] Very good; [c] B October 1; [d] A October 8–22; B October 12 to 26.
774	Sacsek	85.79	125.00	2,002.50	[a] Fairly good; [c] October 4; [d] A and B October 8–25.
1125	Pinili a Biit	88.90	117.50	427.50	[a] Fairly good; [d] A and B to October 20.
1181	Pol-lique	97.42	115.50	1,057.50	[a] Very good; [b] 1 per cent; [d] A and B October 20.
1184	Ugnas	104.41	115.50	1,032.50	[a] Very good; [b] 1 per cent; [d] A and B September 22 October 20.
1073	Calibug	95.89	127.50	1,550.00	[a] Very good; [b] 1 per cent; [c] B October 1; [d] A October 12–27; B October 12–20.
1231	Nagoyon	91.16	125.50	1,102.50	[a] Good; [b] 1 per cent; [d] A and B October 8 28.
1101	Langauisan	97.04	124.00	1,492.50	[a] Very good; [b] 1 per cent; [d] A and B October 8–25.
1103	Lubang Blanco	79.49	127.00	1,342.50	[a] Good; [b] A and B October 5; [d] A and B October 11–28.
1110	Mangasa	80.52	127.00	1,365.00	[a] Good: [b] very slight fungus attack; [c] A to October 1; [d] A and B October 11–28.

[a] General condition of crop.
[b] Per cent destroyed by rats, birds, insect, and fungus attack, etc.
[c] Date headed.
[d] Date matured.
[e] Continuation of September, 1920, Report.

TABLE V.—*Variety test of upland rice at La Carlota Experiment Station for the year 1920*—Continued

Permanent No.	Variety name	Height of plants at maturity	Age of plants at maturity	Yield per hectare	General remarks (1920) [e]
		Cm.	*Days*	*Kilos*	
936	Inanod	89.13	127.50	982.50	[a] Very good; [c] B October 1; [d] A October 10–26; B October 12–28.
724	Putyucanon	92.43	124.25	1,257.50	[a] Very good; [b] 5 per cent; [c] A and B to October 1; [d] A and B October 9–27.
969	Binucaue	90.69	123.25	1,185.00	[a] Good; [b] very slight fungus attack; [c] October 1; [d] A and B October 8–27.
956	Inantipolo II	78.74	122.00	1,200.00	[a] Good; [b] very slight fungus attack; [c] October 8; [d] A and B October 10–27.
987	Magdalena	63.97	127.50	1,152.50	[a] Good; [b] very slight fungus attack; [c] A October 1; [d] A and B October 12–28.
1387	Pinalenke	83.80	126.50	1,090.00	[a] Good; [b] very slight fungus attack; [c] A and B to October 6; [d] A and B October 8–29.
1146	Casulig	89.60	126.00	1,217.50	[a] Good; [b] very slight fungus attack; [c] A October 7; B October 9; [d] A October 9–28; B October 9–29.
970	Cayangcang	86.78	126.50	1,285.00	[a] Fairly good; [b] very slight fungus attack; [c] A October 8; B October 6; [d] A October 10–29; B October 9–29.
1138	Sinampaga	87.73	123.00	995.00	[a] Good; [b] very slight fungus attack; [c] A October 5; B October 11; [d] A October 10–27; B October 10–29.
78	Binagontauo	82.00	122.00	1,075.00	[a] Good; [b] very slight fungus attack; [c] A October 2; B October 3; [d] A October 10–27; B October 11–27.
92	Binicol I	88.33	126.50	1,542.50	[a] Good; [b] very slight fungus attack; [c] A and B October 3; [d] A and B October 12–26.
1166	Kinandang Kumpol	92.87	126.50	1,512.50	[a] Good; [b] very slight fungus attack; [c] A and B to October 2; [d] A and B October 12–26.
718	Pulupot	91.86	120.00	1,557.50	[a] Good; [b] very slight fungus attack; [c] A to October 1; [d] A October 10–25; B October 11–25.
1160	Cucuam	89.97	120.50	1,007 50	[a] Fairly good; [b] very slight fungus attack; [c] A to October 1; [d] A and B October 2–25.
1179	Piniling	89.07	124.50	1,165.00	[a] Very good; [b] very slight fungus attack; [c] A to September 28; [d] A and B October 7–27.
1152	Bangol	71.29	125.50	1,107.50	[a] Fairly good; [b] very slight fungus attack; [d] A to September 29; [d] A and B October 7–29
1178	Piatan	100.25	126.00	1,297.50	[a] Fairly good; [b] 50 per cent heads attacked by fungus; [c] A to September 29; [d] A and B October 8–27.
1226	Mangara	82.62	126.25	1,270.00	[a] Fairly good; [b] very slight fungus attack; [c] A October 1; B October 7; [d] A October 7–29; B October 9–20.
1234	Piniling Bebay	82.39	131.00	915.00	[a] Fair; [b] very slight fungus attack; [c] A October 12; B September 28 to October 14; [d] A October 16–29; B October 18–31.

[a] General condition of crop.
[b] Per cent destroyed by rats, birds, insect, and fungus attack, etc.
[c] Date headed.
[d] Date matured.
[e] Continuation of September, 1920, Report.

TABLE V.—*Variety test of upland rice at La Carlota Experiment Station for the year 1920*—Continued

Permanent No.	Variety name	Height of plants at maturity	Age of plants at maturity	Yield per hectare	General remarks (1920) [e]
		Cm.	*Days*	*Kilos*	
1213	Inagsaya	105.60	126.50	1,140.00	[a] Good; [b] slight fungus attack; [c] A October 7; B October 1; [d] A October 9–20; B October 7–29.
1149	Bagsang	104.27	127.00	1,125.00	[a] Fairly good; [b] slight fungus attack; [c] A September 16–27; [d] A and B October 9–28.
999	Hinirang	73.43	114.75	1,760.00	[a] Good; [b] slight fungus attack; [c] A October 3–19; B October 4–19.
967	Binundoc II	76.07	124.00	1,337.50	[a] Good; [b] slight fungus attack; [c] A and B October 7; [d] A and B October 10–27.
1089	Diquet a Pinasagad	81.54	114.00	780.00	[a] Fairly good; [b] slight fungus attack; [c] A and B October 12; [d] A and B October 14–31
1148	Tuhao or Caot	82.78	126.50	980.00	[a] Fairly good; [b] slight fungus attack; [c] A and B October 6; [d] A and B October 12–29.
619	Minantica Pilit	103.87	125.00	[f] 572.00	[a] Fairly good; [b] 50 per cent; [c] A October 4; B October 2; [d] A and B October 11–27.
1006	Palongpong	98.42	130.00	[f] 3,675.00	[a] Fairly good; [b] 75 per cent; [c] A October 10; B October 12; [d] October 19–29.
1111	Mayoro II	74.88	115.50	675.00	[a] Fairly good; [b] 1 per cent; [c] to October 7; [d] October 10–29.
815	Sinacoban	102.60	115.50	782.50	[a] Fairly good; [b] 75 per cent; [c] A October 5; B October 8; [d] October 10–29.
945	Catalong	108.20	115.50	([h])	[a] Fairly good; [c] October 8; [d] October 10–29.
126	Bulandi	98.90	116.00	697.50	[a] Good; [b] 25 per cent; [c] A October 11; B October 13; [d] A October 10–28; B October 15–29.
1283	Menita	75.73	127.00	400.00	[a] Good; [c] October 10; [d] October 14–28.
1330	Naglihim	68.46	130.50	1,262.50	[a] Good; [c] October 8–26; [d] October 28 to November 10.
1001	Apostol	78.70	148.00	967.50	[a] Good; [b] 1 per cent; [c] October 10–28; [d] November 1–18.
1346	Kinalangkang	89.18	115.50	592.50	[a] Fairly good; [b] 1 per cent; [c] A October 5; B October 6; [d] October 10–27.
1312	Capayong	72.00	114.50	805.00	[a] Fairly good; [b] 25 per cent; [c] A October 5; B October 6; [d] October 10–27.
1334	Pilit morado	102.70	115.50	1,295.00	[a] Good; [c] October 6; [d] October 10–28.
1302	Binagacay	98.80	115.50	1,230.00	[a] Good; [b] 25 per cent; [c] October 6; [d] October 10–28.
1288	Agsam	83.78	115.50	1,175.00	[a] Good; [b] 25 per cent; [c] October 6; [d] October 10–28.
1237	Binalinting Famy	91.08	115.50	460.00	[a] Good; [b] 50 per cent; [c] A October 4; B October 8; [d] October 10–28.
269	Capotol II	80.75	129.00	880.00	[a] Very good; [b] 1 per cent; [c] October 10; [d] October 14-29.
1309	Caña Bombo	91.73	124.00	462.50	[a] Fairly good; [b] 50 per cent; [c] October 1; [d] October 7–28.
959	Magpile	just fully headed, plants....			[a] Fair; leaves yellowish; field very clean.
1286	Minacan	97.55	123.50	502.50	[a] Very good; [b] 20 per cent; [c] October 8; [d] October 8–26.

[a] General condition of crop.
[b] Per cent destroyed by rats, birds, insect, and fungus attack, etc.
[c] Date headed.
[d] Date matured.
[e] Continuation of September, 1920, Report.
[f] Only yield of Plot A was used.
[h] Being threshed.

TABLE V.—*Variety test of upland rice at La Carlota Experiment Station for the year 1920*—Continued

Permanent No.	Variety name	Height of plants at maturity	Age of palnts at maturity	Yield per hectare	General remarks (1920) [e]
		Cm.	*Days*	*Kilos*	
1324	Kinacao	97.96	127.50	1,390.00	[a] Fairly good; [c] October 8; [d] October 11–29.
1330	Layag	97.60	110.25	625.00	[a] Good; [d] A October 10; B October 14.
1316	Dayome	102.97	123.50	367.90	[a] Fairly good; [b] 50 per cent; [c] September 29–October 10; [d] October 20 to November 7.
1305	Cabayo	103.27	116.50	95.00	[a] Poor; [b] 70 per cent; [c] A October 8; B. September 30 to October 8; [d] October 12–31.
1343	Quinukong Oak Sta. Maria	92.63	118.00	410.25	[a] Fairly good; [b] 20 per cent; [c] A October 8; B. September 28 to October 10; [d] A October 10–31; B October 16 to November 1.
1319	Galong Sta. Maria	85.41	101.75	(g) 75.00	[a] Fairly good; [b] 50 per cent; [c] B September 16–22; B was only used for computation.
1285	Kinampupoy	82.48	105.75	553.00	[a] Fair; [b] 10 per cent; [d] A October 20; B October 1–22.
448	Inaslom	93.77	103.75	195.75	[a] Fairly poor; [b] 40 per cent; [c] A October 7; B November 1–12; [d] A October 8–22; B October 12–4.
1328	Malagayang Tapol	88.66	122.75	789.50	[a] Fairly good; [c] A October 7; B October 1–10; [d] October 18 to November 8.
85	Balibod	93.74	104.50	(g) 112.50	[a] Fair; [b] 70 per cent; [c] A October 14; B October 1–16; [d] October 20 to November 14; B plot was basis for computation.
282	Caririt	90.17	107.00	79.75	[a] Fair; [b] 20 per cent; [c] A October 14; B October 1–16; [d] October 20 to November 2.
1320	Guinamat	91.20	111.75	(f) 630.50	[a] Fairly good; [b] 20 per cent; [c] B October 18; [d] A October 1–20; B October 18–26.
1322	Guimat	85.37	118.50	407.00	No plot B. [a] Good; [b] 10 per cent; [d] October 1–30.
1315	Danilog	93.88	116.00	319.00	[a] Fairly good; [b] 20 per cent; [c] A October 7; B October 10; [d] A October 10–29; B October 12–31.
1340	Unoy Dagoydoy	75.82	119.50	481.00	[a] Fairly good; [b] 20 per cent [c] A October 11; B October 20; [d] October 8–31.
1367	Colapdos	83.15	125.00	321.75	[a] Fairly good; [b] 10 per cent; [c] October 6–21; [d] October 22 to November 3.
1237	Binalintin	83.25	122.00	530.00	[a] Fairly good; [b] 1 per cent; [c] A October 7; B October 1–12; [d] October 2 to November 1.
1338	Tapacoy	77.43	122.00	(g) 81.00	[a] Fair; [b] 60 per cent; [c] A October 8; B October 1–10; [d] October 20 to November 1.
562	Malagaya	94.80	109.50	176.50	[a] Fair; [b] 70 per cent; [d] October 7–20.
1344	Nagrion	82.13	118.00	(f) 156.00	[a] Fairly good; [b] 10 per cent; [c] October 8; [d] October 15–30.
1289	Amariles	81.18	119.25	245.00	[a] Fairly good; [b] 20 per cent; [c] A October 10; B October 1–15; [d] A October 14–31; B October 15–31;

[a] General condition of crop.
[b] Per cent destroyed by rats, birds, insect, and fungus attack, etc.
[c] Date headed.
[d] Date matured.
[e] Continuation of September, 1920, Report.
[f] Only yield of Plot A was used.
[g] Only yield of Plot B was used.

TABLE V.—*Variety test of upland rice at La Carlota Experiment Station for the year 1920*—Continued

Permanent No.	Variety name	Height of plants at maturity	Age of plants at maturity	Yield per hectare	General remarks (1920) [e]
		Cm.	*Days*	*Kilos*	
254	Capichola	78.52	127.50	197.50	[a] Fair; [b] 80 per cent; [c] October 7–25; [d] October 28 to November 10.
	Inacopanga	84.38	119.00	107.00	[a] Fair; [b] 20 per cent; [c] A October 8; B October 1–12; [d] A October 12 to November 1; B October 16 to November 2.
1348	Cadidi	82.32	132.50	490.50	[a] Fair; [b] 1 per cent; [c] October 8–22; [d] October 26 to November 14.
338	Dali	79.50	145.00	357.50	[a] Fair; [c] October 22 to November 9; [d] November 10–29.
1351	Oyoy	79.63	129.50	478.00	[a] Fair; [b] 50 per cent; [c] October 8–20; [d] October 24 to November 10.
644	Nagsayang Pula	76.47	124.75	106.75	[a] Fairly good; [b] 1 per cent; [c] A October 16; B October 1–16; [d] A October 18 to November 4; B October 20 to November 4.
1299	Bayangbang	68.43	130.50	[g] 88.50	[a] Fairly good; [b] 20 per cent; [c] A October 1–18; B October 3–23; [d] October 24 to November 12.
673	Piniling Baybay	87.00	127.50	[f] 170.00	[a] Fairly good; [b] 3 per cent; [c] October 1–18; [d] October 22 to November 10.
1364	Binagontauo	80.97	118.00	[g] 127.65	[a] Fair; [b] 5 per cent; [c] October 6; [d] October 10 to November 1.
855	Tapol III	92.82	129.50	643.75	[a] Poor; [b] 60 per cent; [c] October 1–18; [d] October 22 to November 10.
520	Lubang Pula	86.52	118.00	669.00	[a] Poor; [b] 60 per cent; [c] A October 6; B September 28 to October 8; [d] October 10 to November 1.
879	Tinomanan	90.24	122.50	[f] 321.00	[a] Poor; [b] 50 per cent; [c] October 1–12; [d] October 20 to November 8.
1325	Kinayabog	98.59	127.50	416.50	[a] Poor; [b] 70 per cent; [c] October 1–20; [d] October 20 to November 10.
1331	Mita	73.05	112.50	[g] 62.50	[a] Fair; [b] 10 per cent; [c] A October 8; B October 12; [d] A October 9–21; B October 13–23.
1311	Carabao	74.13	131.50	558.25	[a] Poor; [b] 50 per cent; [c] October 3–19; [d] October 26 to November 12.
1327	Kinilay	82.25	131.50	120.00	[a] Poor; [b] 50 per cent; [c] October 3–19; [d] October 26 to November 12.
1301	Bihoralog Pula	79.74	126.50	370.75	[a] Poor; [b] 40 per cent; [c] October 6–19; [d] October 22 to November 8.
1310	Caponguit	77.79	122.00	525.25	[a] Good; [b] 1 per cent; [c] October 1–12; [d] October 20 to November 8.
1283	Menita	78.85	114.75	563.00	[a] Fair; [b] 50 per cent; [c] A October 9; B October 1–11; [d] A October 12 to November 6; B October 18 to November 6.

[a] General condition of crop.
[b] Per cent destroyed by rats, birds, insect, and fungus attack, etc.
[c] Date headed.
[d] Date matured.
[e] Continuation of September, 1920, Report.
[f] Only yield of Plot A was used.
[g] Only yield of Plot B was used.

TABLE V.—*Variety test of upland rice at La Carlota Experiment Station for the year 1920*—Continued

Permanent No.	Variety name	Height of Plants at maturity	Age of plants at maturity	Yield per hectare	General remarks (1920) [e]
		Cm.	*Days*	*Kilos*	
1329	Malagoso	78.32	118.75	436.00	[a] Poor; [b] 50 per cent; [c] A October 10; B October 1–12; A October 13 to November 7; B October 18 to November 8.
12	Amayan	78.81	115.00	416.50	[a] Fairly good; [c] A October 10; B October 1–14; [d]. October 14 to November 4; B October 18 to November 6.
1337	Sarocot	83.32	120.25	505.75	[a] Poor; [b] 75 per cent; [c] A October 10; B October 1–12; [d] A October 10 to November 9; B October 14 to November 10.
1308	Caluis	79.70	120.00	742.50	[a] Poor; [b] 50 per cent; [c] October 1–12; [d] October 20 to November 6.
	Oag-oag	63.58	103.00	334.50	[a] Poor; [d] October 1–21.
1318	Galong Famy	75.72	116.50	623.50	[a] Fair; [b] 20 per cent; [c] A October 8. B October 1–10; [d] October 18 to November 1.
1332	Naglantik	100.20	116.50	485.50	[a] Poor; [b] 1 per cent; [c] A October 8; B October 1–10; [d] October 18 to November 1.
1304	Binongang Loay	69.88	116.50	185.20	[a] Poor; [b] 2 per cent; [c] September 26 to October 8; [d] October 18 to November 1.
1313	Carawin	84.20	123.00	([f]) 227.50	[a] Poor; [b] 70 per cent; [c] October 8–20; [d] October 22 to November 10.
1300	Berilhon	73.35	120.50	191.50	[a] Poor; [b] 70 per cent; [c] October 8–20; [d] October 22 to November 7.
777	Sagoboy	88.23	121.50	295.00	[a] Fair; [b] 70 per cent; [c] A October 1–20; B October 2–22.
65	Binabaye	91.04	115.00	([f]) 265.00	[a] Poor; [b] 70 per cent; [c] A October 8; B October 1–10; [d] A October 18 to November 2, B October 20 to November 3.
1339	Tonguitan	71.27	118.00	153.75	[a] Fairly good; [b] 2 per cent; [c] A October 7; B October 8; [d] A October 18 to November 2; B October 20 to November 3.
1307	Cabon	75.21	99.75	645.00	[a] Good; [b] 10 per cent; [d] October 20.
1335	Quinirispinong Puti	77.24	123.00	312.00	[a] Fairly good; [c] October 6–22; [d] October 26 to November 7.
1298	Ban-ar	91.39	109.50	324.50	[a] Fair; [c] A October 2; B October 8; [d]. A October 8–26; B October 10–28.
1303	Binoguinguin	81.17	125.50	179.00	[a] Fairly good; [c] October 2–22; [d] October 28 to November 12.
1047	Caviteña a Biit	75.26	108.25	484.50	[a] Fairly good; . [c] B September 24 to October 2; [d] A October 8–31; B October 9 to November 3.
530	Macan Piña	67.64	125.00	43.25	[a] Poor; [c] October 6–20; [d] October 26 to November 12.
1342	Ñgapol	86.40	119.00	216.50	[a] Poor; [c] October 1–20; [d] October 24 to November 2.
1333	Luyot	80.80	115.50	220.00	[a] Fair; [c] October 10; [d] October 18 to November 1.

[a] General condition of crop.
[b] Per cent destroyed by rats, birds, insect, and fungus attack, etc.
[c] Date headed.
[d] Date matured.
[e] Continuation of September, 1920, Report.
[f] Only yield of Plot A was used.
[g] Only yield of Plot B was used.

TABLE V.—*Variety test of upland rice at La Carlota Experiment Station for the year 1920*—Continued

Permanent No.	Variety name	Height of plants at maturity	Age of plants at maturity	Yield per hectare	General remarks (1920) [e]
		Cm	*Days*	*Kilos*	
1341	Buaoa	85.72	117.50	223.75	[a] Poor; [c] October 1–12; [d] October 20 to November 3.
1350	Arao	65.27	106.00	([h])	[a] Poor; [c] October 20 to November 1; [d] November 8–23.
1314	Cuoab	78.27	117.50	220.00	[a] Poor; [c] October 1–12; [d] October 20 to November 9.
572	Malido	78.16	119.50	126.00	[a] Fair; [c] October 12–20; [d] October 22 to November 4.
1482	Pinili	68.43	110.00	[f] 82.50	[a] Poor; [b] 40 per cent; [c] October 20 to November 8; [d] November 12–20.
306	Catorsa	63.17	126.00	43.50	[a] Poor; [c] October 8–20; [d] October 28 to November 8.
120	Bulagsao I	67.94	117.50	349.75	[a] Poor; [b] 80 per cent; [c] September 28 to October 9; [d] October 18 to November 1.
1562	Kinastila	78.73	107.00	100.50	[a] Poor; [c] A October 12; B October 1–13; [d] October 20 to November 4.
1489	Inantaka	80.09	121.00	188.75	[a] Poor; [b] 60 per cent; [c] A October 1–20; B October 2–22; [d] October 22 to November 4.
1561	Lintang Anod	72.30	119.00	[g] 122.00	[a] Poor; [b] 40 per cent; [c] A October 12; B October 1–13; [d] October 20 to November 2.
1292	Early Prolific	69.68	107.00	35.55	[a] Poor; [b] 1 per cent; [d] A October 7–23, B October 8–24.
1500	Macapno	61.50	127.50	672.00	[a] Fair; [c] October 1–20; [d] October 23 to November 18.
1565	Kinamantigue	78.86	106.75	132.50	[a] Fairly good; [c] B October 1–12; [d] A October 1–22; B October 12–24.
1490	Sinaria	85.25	118.50	220.00	[a] Poor; [b] 80 per cent; [c] October 4–18; [d] October 22 to November 2.
1267	Carolina Gold	78.29	110.00	402.50	[a] Fair; [b] 10 per cent; [c] A September 28 to October 8; B October 9; [d] October 10–28; B October 11–29.
1486	Ipon	....	....	....	Just heading.
1386	Panay	81.85	113.50	460.00	[a] Poor; [b] 50 per cent; [c] October 3–18; [d] October 20 to November 2.
515	Lubang II	74.31	114.50	457.50	[a] Fair; [b] 50 per cent; [c] October 1–20; [d] October 21 to November 2.

[a] General condition of crop.
[b] Per cent destroyed by rats, birds, insect, and fungus attack, etc.
[c] Date headed.
[d] Date matured.
[e] Continuation of September, 1920, Report.
[f] Only yield of Plot A was used.
[g] Only yield of Plot B was used.
[h] Being threshed.

HEAD-TO-THE-ROW TEST

The 6 varieties used in this test were planted June 18 to June 21, 1920, inclusive. From each of these varieties 10 best plants were selected for the 1921 initial head-to-the-row selection.

Table VI shows the length of culms, total number of culms, number of bearing culms, weight of good grains, and percentage of good grains of the individual selected plant.

TABLE VI.—*Head-to-the-row test of upland rice at La Carlota Experiment Station for the year 1920*

Plant number or stock number	Length of culms	Total number of culms	Total number of bearing culms	Weight of good grains	Per cent of good grains
	Cm.			*Grams*	
BULUHAN					
983–1Y0000	74.90	14	14	19.684	85.00
983–1Y0001	80.86	12	12	19.628	84.88
983–1Y0002	64.48	12	12	18.928	67.92
983–1Y0003	70.88	12	12	24.766	87.34
983–1Y0004	77.33	12	12	25.056	86.90
983–1Y0005	65.44	10	10	20.100	93.06
983–1Y0006	80.69	10	10	23.452	86.46
983–1Y0007	75.00	10	10	24.024	86.87
983–1Y0008	75.08	9	9	20.708	86.05
983–1Y0009	75.63	9	9	15.183	81.19
DALIKET OR SANGLAY					
966–2Y0000	87.91	12	12	25.680	88.24
966–2Y0001	84.64	12	12	26.688	92.00
966–2Y0002	84.19	11	10	23.403	84.19
966–2Y0003	87.22	11	11	17.550	94.81
966–2Y0004	77.41	11	11	14.688	88.89
966–2Y0005	93.12	12	12	28.028	88.12
966–2Y0006	80.80	11	11	15.663	96.84
966–2Y0007	90.20	6	6	13.473	90.20
966–2Y0008	92.00	8	8	21.456	99.02
966–2Y0009	87.60	6	6	11.000	95.84
INANTITOLO II					
956–3Y0000	87.39	12	11	28.755	64.83
956–3Y0001	84.20	7	6	26.289	68.35
956–3Y0002	84.48	6	6	42.650	73.48
956–3Y0003	94.56	4	4	30.072	61.92
956–3Y0004	93.45	6	6	27.462	83.36
956–3Y0005	94.48	5	5	20.700	84.43
956–3Y0006	93.56	5	5	29.421	79.42
956–3Y0007	100.25	5	4	17.556	100.00
956–3Y0008	94.60	5	5	23.784	86.18
956–3Y0009	94.42	5	5	18.984	78.07
LUBANG BLANCO					
1103–4Y0000	76.56	12	12	13.514	83.33
1103–4Y0001	66.79	11	11	11.284	84.78
1103–4Y0002	76.81	10	10	19.952	83.13
1103–4Y0003	73.52	10	10	16.907	73.52
1103–4Y0004	71.13	10	10	19.053	83.33
1103–4Y0005	84.71	9	9	25.766	81.36
1103–4Y0006	76.27	8	8	10.395	85.25
1103–4Y0007	75.94	9	9	18.360	75.94
1103–4Y0008	80.40	8	8	14.718	77.50
1103–4Y0009	97.22	8	6	26.730	71.14
MACAN II					
1049–5Y0000	69.22	13	11	14.160	85.51
1049–5Y0001	73.47	8	8	10.108	86.36
1049–5Y0002	66.70	8	8	9.424	88.41
1049–5Y0003	63.62	12	12	16.875	80.36
1049–5Y0004	68.01	9	8	9.100	83.02
1049–5Y0005	83.61	8	8	9.200	82.67
1049–5Y0006	67.70	7	7	8.760	85.71
1049–5Y0007	74.89	7	7	12.258	84.15
1049–5Y0008	65.24	7	7	10.948	84.75
1049–5Y0009	67.71	7	7	10.672	86.89
SAMBAN					
1133–6Y0000	88.75	7	7	40.400	97.02
1133–6Y0001	103.26	7	7	25.760	89.57
1133–6Y0002	94.40	7	7	20.020	88.71
1133–6Y0003	94.67	6	6	18.542	93.21
1133–6Y0004	97.65	6	6	24.505	84.57
1133–6Y0005	90.13	6	6	26.712	87.42
1133–6Y0006	89.07	6	6	16.733	85.09
1133–6Y0007	76.20	6	6	24.528	88.02
1133–6Y0008	92.78	5	5	20.306	84.07
1133–6Y0009	97.80	5	5	18.765	80.70

[a] Diseased grains excluded.

MONTHLY VARIETY TEST

The results show that all varieties planted in the first and second plantings and one-half of those in the third planting produced crops of only very inferior quality. The plants in all series of plantings were very much dwarfed, but they headed and matured very much earlier than the same varieties planted in regular season.

Table VII shows the yields of the same varieties planted at different dates: first planting, to September 20, 1919; second planting, to October 24, 1919; third planting, to November 24, 1919.

TABLE VII

Permanent No.	Variety name	Computed yield per hectare				Gain over the yield of—			General remarks
		Regular season	First planting	Second planting	Third planting	First planting	Second planting	Third planting	
		Kilos	*Kilos*	*Kilos*	*Kilos*	*Kilos*	*Kilos*	*Kilos*	First and second plantings were badly damaged by atangia and dry weather. Third planting was badly damaged by very dry weather.
1001	Apostol	2,454.52	6.66	76.67	00	2,447.86	2,377.85	2,454.52	
1068	Bulao IV	2,754.50	186.66	36.67	14.67	2,567.84	2,717.83	2,739.83	
983	Buluhan	3,067.25	26.66	5.00	8.00	3,040.59	3,062.25	3,059.25	
78	Binagontauo	1,477.54	6.66	6.67	00	1,470.88	1,470.87	1,477.54	
966	Daliket or Sanglay	3,476.25	120.00	6.67	37.34	3,356.25	3,469.58	3,438.91	
362	Dinagat I	1,907.70	33.33	5.34	38.67	1,874.37	1,902.36	1,869.03	
956	Inantipolo II	1,610.77	6.66	8.00	00	1,604.11	1,602.77	1,610.77	
1048	Inintiw	2,833.50	120.00	6.00	23.34	2,713.50	2,827.50	2,810.16	
1049	Macan II	3,155.70	126.66	6.00	20.00	3,029.04	3,149.70	3,135.70	
1230	Naglihim	2,812.38	6.66	2.00	00	2,805.72	2,810.38	2,812.38	
574	Maliro	1,581.80	6.66	3.34	00	1,575.14	1,578.46	1,581.80	
958	Macatibos I	2,856.75	....	3.34	00	....	2,853.41	2,856.75	

The 4th and 5th plantings could not produce any grains due to dry weather.

The causes responsible for the inferiority of the crops were dry weather, and the attacks of birds and insects as observed and noted in our previous reports.

To get more reliable results the experiment was continued using the same varieties as used in the previous year's cultures throughout. The land used had been planted to rice then also. The first, second, third and fourth series of plantings were done in drills in rows 50 centimeters apart on September 3, October 4, November 8, and December 5, 1920, respectively. Each variety excepting in the first series of planting (4 rows only) occupied 5 rows 10 meters long each. Each row was planted at the following rates of seedlings per hectare: first row, 8 gantas; second row, 12 gantas; third row, 16 gantas; fourth row, 20 gantas; fifth row, 24 gantas. (The basis of computation is 100 per cent germination.)

In the second planting each row was 50 meters long instead of 10 meters.

The seeds used in the first, second, and third series of plantings were taken from the 1919 variety test seed palay. Newly harvested seeds were used in the fourth planting.

Table VIII shows the condition of the plants in the first, second, third, and fourth series of plantings up to December 14, 1920.

Series of planting	Height of plants, December 14, 1920					Condition of plants, December 14, 1920	General remarks
	Row number						
	1	2	3	4	5		
	Cm.	*Cm.*	*Cm.*	*Cm.*	*Cm.*		
1001 Apostol:							
First	69.9	62.0	65.5	65.4	......	Very good	Heading; slight atangia attack.
Second	40.2	44.5	44.1	44.3	36.8	Fair	Four to five rows, pale yellow; first to third rows, good.
Third	33.4	30.2	31.3	35.6	34.9	Fairly good	Weeded once.
Fourth	1.5	1.2	1.4	1.0	1.2	Good	Not all germinated.
78 Binagontauo:							
First	82.1	98.2	76.8	74.7	......	Plants very good	Heading.
Second	37.8	38.1	34.3	51.4	46.5	Fairly good	Plants' leaves slightly yellowish.
Third	......	......	......	......	......	None germinated	Weeded once.
Fourth	1.0	1.1	0.9	1.0	1.2	Good	Not all germinated.
1068 Bulao IV:							
First	66.7	72.9	67.1	58.7	......	Very good	In full head.
Second	73.1	74.6	70.4	78.6	72.9	do	About to head.
Third	44.3	40.2	40.9	46.3	35.2	do	Weeded once.
Fourth	0.8	1.0	0.9	1.2	1.4	Good	Just germinated.
983 Buluhan:							
First	60.5	58.9	53.1	58.9	59.1	Fairly good	Matured; slight fungus and insect attack.
Second	59.1	59.4	57.6	57.3	52.7	Plants very good	In full head. Atangia attacked plants.
Third	40.1	38.2	39.9	39.6	42.9	Very good	Very good.
Fourth	0.5	0.8	1.0	0.6	0.9	Fairly good	Not all germinated.
966 Daliket or Sanglay:							
First	60.1	52.5	45.9	49.0	......	Poor	Beginning to mature; slight insect attack.
Second	51.8	57.2	41.4	41.7	37.8	Very poor, pale	Some plants heading.
Third	36.2	41.3	32.1	31.5	33.7	Fairly good	Weeded once.
Fourth	1.0	1.1	0.9	1.0	1.2	Fair	Just germinated.
362 Dinagat I:							
First	46.5	51.5	48.6	49.9	......	Fairly good	Maturing; greatly damaged by insects.
Second	35.7	40.0	47.7	31.9	45.8	Good, green	Heading; heads very small.
Third	26.1	27.1	29.2	28.9	29.3	Fairly good	Very few plants germinated.
Fourth	1.1	1.0	0.9	1.2	1.1	Good	Just germinated.
956 Inantipolo II:							
First	48.0	50.4	51.8	53.1	......	do	Fourth row, very poor heading.
Second	51.8	51.2	59.6	51.7	49.0	Fairly good	Plants about to head.
Third	26.8	26.2	25.7	27.4	29.6	do	Weeded once.
Fourth	0.8	1.0	0.6	0.8	1.1	Fair	Not all germinated.
1048 Inintiw:							
First	61.4	57.0	56.5	46.1	......	Good	Maturing—; slightly damaged by insects.
Second	48.1	51.9	56.4	44.3	33.5	Fairly good	Heading; heads very small.
Third	28.4	31.6	36.7	33.4	32.2	do	Weeded once.
Fourth	1.2	1.1	1.0	1.3	1.0	Good	Just germinated.
1049 Macan II:							
First	61.4	57.4	56.5	46.1	......	Fairly good	Maturing; very slight insect attack.
Second	40.3	34.8	42.5	42.3	33.6	Very good, green	Heading; small heads.
Third	32.8	32.6	30.5	32.3	31.7	Fairly good	Weeded once.
Fourth	1.0	1.2	1.1	1.0	1.0	Fair	Just germinated.
958 Macatibos I:							
First	64.5	50.7	53.8	43.4	......	Fairly good	Maturing.
Second	44.5	57.1	48.0	35.4	51.9	Very good	About heading.
Third	36.9	31.3	32.5	34.2	26.7	Fair	Weeded once.
Fourth	1.2	1.4	0.9	0.7	1.0	Good	Just germinated.

Series of planting	Height of plants, December 14, 1920					Condition of plants, December 14, 1920	General remarks
	Row number						
	1	2	3	4	5		
1230 Naglihim:	*Cm.*	*Cm.*	*Cm.*	*Cm.*	*Cm.*		
First	62.3	58.8	33.4	56.3	......	Very good	Heading; slightly attacked by insects.
Second	45.3	41.9	44.7	43.8	46.1	.....do	Not heading.
Third	34.6	33.4	29.8	30.2	33.7	Fairly good	Weeded once.
Fourth	[a] 0.5	0.8	1.0	1.1	1.0	Fair	Not all germinated.
574 Maliro:							
First	104.7	96.7	90.3	83.4	......	Very good	Heading.
Second	75.3	60.2	77.6	79.7	70.2	Plants good	Very few plants growing.
Third	48.4	38.6	34.8	39.7	35.8	Plants fair	Weeded once.
Fourth	([b])	1.0	0.8	0.7	0.9	Fair	Not all germinated.

[a] Very few plants. [b] None germinated.

One object of this test was to determine the best rate of seeding when planting in drills in rows 50 centimeters apart.

OBSERVATION ON THE VIABILITY OF THE DIFFERENT VARIETIES OF UPLAND RICE

This experiment was started on November 21, 1920. The varieties used were the Inantipolo II, the Lubang Blanco, the Macan II, the Macatibos I, the Mayoro II, the Daliket, the Buluhan, the Tuhao or Caot, the Sanglay Puti, and the Kinastila V. Due to shortage of materials only five gantas of each of these varieties were placed in sacks for the experiment, and five gantas each of the Inantipolo II, the Lubang Blanco, and the Macatibos I were used as the check throughout. Monthly germination tests were performed with the check and quarterly germination tests with the experiment from the first test for 9 months; monthly thereafter with the experiment, and bimonthly germination tests with the check.

The data obtained from the first test are shown in Table IX.

TABLE IX.—*Viability test of upland rice at La Carlota Experiment Station for the year 1920*

Permanent No.	Variety name	Percentage of germination	Condition of seeds, December 16, 1920
956	Inantipolo II	83	Good. No insect attack.
956	.....do....(check)	75	Do.
1103	Lubang Blanco	75	Fairly good. No insect attack.
1103	.....do....(check)	28	Do.
1049	Macan II	95	Good.
958	Macatibos I	95	Do.
958	.....do....(check)	98	Do.
1111	Mayoro II	97	Do.
966	Daliket	93	Do.
983	Buluhan	92	Do.
1148	Tuhao or Caot	95	Do.
1148	.....do....(check)	97	Do.
791	Sanglay Puti	97	Do.
1050	Kinastila V	99	Do.

The varieties used were harvested as follows: Lubang Blanco, November 9, 1920; Tuhao or Caot, October 25; Inantipolo II, October 27; Mayoro II, October 11; Macan II, October 22; Macatibos I, August 21; Sanglay puti, October 28; and Daliket or Sanglay, October 27.

GENERAL VARIETY TEST

For the 1921 general variety test 209 varieties of upland rice were planted at La Carlota May 9–12, inclusive, in hills 8 centimeters apart in rows 50 centimeters apart. The hills were later thinned out. Among the 209 varieties planted 3 varieties were from the United States, 2 from China, 9 from Japan, 9 from Saigon, 5 from Siam, and 181 from different provinces of the Philippines. Most of the Japanese and Chinese varieties showed poor germinating quality. With the exception of 1189-Takenari they were very early maturing. The Saigon varieties were too late maturing. On November 29, 1921, they were in the flowering stage, so they were open to the attacks of numerous enemies such as atangia, rats, birds, etc.

All of the varieties showed good growth but due to unfavorable weather at harvesting time the resulting crops were not so good as expected.

Table X shows the results of the variety test for the year 1921.

TABLE X.—*Variety test of upland rice at La Carlota Experiment Station for the year 1921*

Permanent No.	Variety name	Source	Height of plants at maturity	Age of plants at maturity	Actual per cent of plants harvested	Computed yield per hectare 100 per cent stand	Actual yield per hectare
			Cm.	*Days*		*Kilos*	*Kilos*
933	Omachi	Japan	62.2	....	10	627.84	62.78
1358	Tamasuri	do	84.8	89	11.4	976.64	111.22
1190	Miyako II	do	([a])	([a])	([a])	([a])	([a])
1225	Japanese Rice (No name)	do	([a])	([a])	([a])	([a])	([a])
1188	Sekitori	do	92.2	99	66.7	2,697.70	1,799.37
1558	Daliket	Laguna	103.8	97	66.7	2,255.34	1,504.31
1353	Aikoku	Japan	50.3	93	2.4	278.4	6.68
1359	Urasan	do	86.1	96	4.1	279.04	11.44
1281	Chinese Autumn crops	China	([a])	([a])	([a])	([a])	([a])
1280	Chinese first crop	do	([a])	([a])	([a])	([a])	([a])
983	Buluhan	Batangas	88.3	102	50	1,656.0	828.00
1559	Cutsiam		126.6	120	100	1,208.0	1,208.00
958	Macatibos	Occidental Negros	104.1	102	61.50	651.1	400.43
1560	Buluhan		100.9	120	100	1,628.0	1,628.00
1307	Cabon	Tayabas	98.4	104.0	75	2,788.5	2,091.38
1290	Blue Rose I	U. S. A	86.2	108	45.2	1,522.10	687.99
1147	Cutsiam II	Occidental Negros	85.9	118	62.5	2,524.0	1,577.50
1319	Galong Sta. Maria	Laguna	105.6	118	71.4	....	....
1385	Guinatos		96.2	111	62.5	3,699.2	2,312.00
1287	Oag Oag	Ilocos Norte	92.5	119	71.4	1,372.8	980.18
1357	Oba	Japan	96.1	124.5	60.0	2,000.00	1,200.00
515	Lubang II	Antique	104.3	128.0	66.7	973.0	648.99
1285	Kinampupoy	Bulacan	104.7	121	76.9	728.0	559.83
1068	Bulao IV	Cotabato	114.8	111	100	1,436.0	1,436.00
1049	Macan II	Laguna	80.2	122	100	2,016.0	2,016.00
1321	Guinanay		83.3	125	50	1,004.0	502.00

[a] No good seed produced due to atangia attack.

TABLE X.—*Variety test of upland rice at La Carlota Experiment Station for the year 1921*—Continued

Permanent No.	Variety name	Source	Height of plants at maturity	Age of plants at maturity	Actual per cent of plants harvested	Computed yield per hectare 100 per cent stand	Actual yield per hectare
			Cm.	*Days*		*Kilos*	*Kilos*
1562	Kinastila	Cavite	104.4	116	83.3	1,258.10	1,048.00
1292	Early Prolific	U. S. A	99.9	121	40	1,050.00	420.00
562	Malagaya	Tayabas	101.5	126	58.8	1,408.1	827.96
1345	Caviteña a biit	Ilocos Sur	89.0	120	66.7	890.5	593.89
1298	Ban-ar	Abra	117.0	120.5	83.3	1,421.3	1,184.14
1330	Layag	Kalinga	92.0	122	50	1,736.0	868.00
1267	Carolina Gold	U. S. A. Louisiana	112	119	100	1,908.0	1,908.0
990	Kaawa	Rizal	105	115	40	1,000.0	400.0
1565	Kinamantigue	Bataan	114	125.5	41.7	1,079.3	450.07
363	Dinagat II	Laguna	107	117	99.1	1,413.7	1,400.98
448	Inaslom	Oriental Negros	109	123.5	99.2	1,195.1	1,130.54
1326	Kinanda	Bataan	105	122.5	62.5	2,496.0	1,560.00
1557	Kinanda II	Cavite	113	117	92.2	887.1	641.81
1193	Kinastila VII	Batangas	108.5	122.5	90.9	1,160.2	1,054.62
1320	Guinamat	Kalinga	105	123	45.4	1,938.3	879.99
1389	Cainte III		114	123.5	100	840.0	840.00
639	Nagdami		114	114.5	83.3	867.1	722.29
1331	Mita	Tayabas	82	123.5	32.6	1,239.2	404.98
1217	Kinandang Puti	Batangas	107	112	83.3	3,106.8	2,587.96
1386	Panay	do	106	114.5	91.4	2,645.0	2,417.53
1234	Piniling Bebay	Nueva Ecija	114	135.5	45.4	2,378.8	1,079.98
980	Kinastila IV	Batangas	107	113	90.4	2,681.4	2,423.95
1158	Cammang	Nueva Ecija	107	121	45.4	4,029.4	1,829.35
1312	Capayong	Oriental Negros	111	140.5	71.4	1,064.4	758.98
966	Daliket or Sanglay	Cavite	122	119	83.3	2,895.5	2,411.95
999	Hinirang	Zambales	87	131.5	83.30	1,043.2	868.99
1048	Inintiw	Laguna	104	125	90.9	704.1	640.03
1100	Lampadan or Allangigan	Pangasinan	111	121.0	55.6	4,129.6	2,296.06
1283	Menita	Laguna	106	126.0	100	840.0	840.00
1181	Pol-lique	Bontoc	110	127	74.6	466.2	347.79
1050	Kinastila V		120	118.5	83.3	2,549.8	2,123.98
1288	Agsam	Tayabas	104	102	71.4	1,848.7	1,155.44
12	Amayan	do	101	128.5	62.5	504.2	315.13
1302	Binagacay	Oriental Negros	109	99.5	90.9	1,628.2	1,480.03
1237	Binalinting	Laguna	102	92.5	59.1	2,538.1	1,500.02
65	Binabaye	Tayabas	94	93.5	62.5	861.0	538.13
943	Bonguet	Surigao	109	122.5	83.3	1,546.2	1,287.98
1346	Kinalangkang	Tayabas	96	151	66.7	944.5	629.98
1216	Kinandang Pula	Batangas	127	122	62.5	1,120.0	700.00
1333	Luyot	Abra	110	120.5	90.9	1,210.1	1,099.98
1334	Pilit Morado	Oriental Negros	111	122	71.4	1,400.5	999.96
1165	Kinalabao Purao	Nueva Ecija	(b)	(b)	(b)	(b)	(b)
1184	Ugnas	Bontoc	100	124.5	59.1	1,555.2	919.12
1304	Binoguinguing Loay	Tayabas	111	124	76.9	1,403.1	1,078.98
1305	Cabayo	Samar	92	134	66.7	869.6	589.82
1315	Danilog	Kabuk	103	125.5	66.7	1,784.1	1,189.99
347	Dappog	Bulacan	104	122	66.7	1,259.3	839.95
362	Dinagat I	Cotabato	104	123	62.5	480.0	300.00
1318	Galong Famy	Laguna	110	125	83.3	1,056.4	879.98
1332	Naglantik	Tayabas	110	130.5	83.3	996.4	830.00
791	Sanglay Puti	Zambales	124	126	59.1	1,556.6	931.05
282	Caririt	Oriental Negros	108	128	90.9	1,540.2	1,400.04
1150	Balasang	Nueva Ecija	105	119.5	55.6	503.6	280.00
1125	Pinili a Biit	Pangasinan	108	119.5	76.9	619.0	476.03
1133	Samban	Cotabato	107	117.5	52.6	4,000.0	2,104.00
120	Bulagsac I	Zambales	111	133	90.9	1,760.1	1,599.93
1341	Buaoa	Abra	103	124.5	83.3	912.4	753.43
1314	Cuoab	do	135	124.5	52.6	2,148.3	1,130.01
1364	Binagontauo	Tayabas	125	128	83.3	1,824.7	1,519.98
1161	Dinalaga V	Batangas	96	126.5	83.3	1,620.6	1,349.96
1322	Guimat	Kalinga	113	123	59.1	2,367.2	1,409.02
520	Lubang Pula	Bohol	97	130	76.9	2,054.5	1,579.91
1329	Malagoso	Oriental Negros	96	133	90.9	1,789.9	1,627.02
1344	Nagrion	Tayabas	113	101	100	812	812.00
1343	Uwak Sta. Maria		105	136.5	90.9	1,009.9	918.00
1490	Sinaria	Ambos Camarines	116	127.5	43.5	1,494.2	649.98
1189	Takenari	Japan	110	127.5	83.3	2,056.4	1,712.98
1339	Tonguitan	Kalinga	116	129.5	71.4	1,368.3	976.97
1289	Amariles		107	131	45.4	2,907.5	1,320.01
1323	Inacopanga	Laguna	119	128.5	83.3	1,786.3	1,487.99
1561	Lintang Anod	Ambos Camarines	106	131	90.9	1,914.12	1,739.94

[b] Eaten by animals.

TABLE X.—*Variety test of upland rice at La Carlota Experiment Station for the year 1921*—Continued

Permanent No.	Variety name	Source	Height of plants at maturity	Age of plants at maturity	Actual per cent of plants harvested	Computed yield per hectare 100 per cent stand	Actual yield per hectare
			Cm.	*Days*		*Kilos*	*Kilos*
572	Malido	Samar	120	132	62.5	3,040.0	1,900.00
971	Kinastaño	Batangas	91	133.5	90.9	1,540.2	1,400.04
1342	Ngapol	Abra	107	127	83.3	1,716.7	1,430.01
1300	Berilhon	Samar	109	99	83.3	1,520.2	1,266.33
1308	Caluis	.....do	114	132	83.3	1,444.2	1,181.02
261	Caporcas		107	121	71.4	2,778.7	1,983.99
1160	Cucuam	Nueva Ecija	115	126.0	59.1	1,167.5	689.99
718	Puluput I	Tayabas	100	128	90.9	1,760.2	1,600.02
1337	Sarocot	Samar	108	128.5	100	1,530.0	1,530.00
1136	Sinaba III	Pangasinan	101	128.5	50	1,060.0	530.00
1340	Unoy Dagoydoy	Kalinga	111	118.5	83.3	1,584.6	1,319.97
1489	Minantica	Ambos Camarines	122	133.5	100	1,580.0	1,580.00
777	Sagoboy	Oriental Negros	104	133	100	1,000.0	1,000.00
78	Binagontauo	Ambos Camarines	112	126	90.9	2,266.2	1,969.08
1336	Sinadiaya	Laguna	(c)	(c)	(c)	(c)	(c)
1310	Caponguet	Oriental Negros	118	121.5	90.9	1,971.4	1,792.00
956	Inantipolo II	Cavite	107	134	100	2,300.0	2,300.00
1328	Malagayang Tapol	Oriental Negros	96	128	59.1	1,573.4	929.88
1051	Nagdami II		87.7	90	76.9	1,674.9	1,288.00
1338	Tapacoy	Tayabas	95	133	100	2,360.0	2,360.00
879	Tinomanan	Oriental Negros	106	132	43.5	2,041.4	838.01
1062	Bebe	Tarlac	108	132.5	66.7	1,694.0	1,129.90
969	Binucaue	Batangas	103	122.5	80	1,025.0	820.00
1313	Carawin	Oriental Negros	128	139	62.5	2,064.0	1,290.00
1316	Dayome	Samar	94	138	71.4	2,521.0	1,800.00
1286	Minacan	Bulacan	124	142	100	1,800.0	1,800.00
1335	Quinirispinong Puti	Laguna	117	132	76.9	1,196.4	920.03
1138	Sinampaga	Nueva Ecija	126	135	66.7	2,038.9	1,359.95
967	Binunduk II	.....do	102	142	100	1,064.0	1,064.00
126	Bulandi	Occidental Negros	115	137.5	90.9	1,748.1	1,589.02
1309	Caña Bombo	Laguna	117	122.5	100	1,648.0	1,648.00
1097	Initlog dalag	Cavite	107	132.0	76.9	2,028.6	155.99
1101	Langauisan	Cotabato	113	151	83.3	2,497.0	2,079.00
998	Macarañag II	Pangasinan	107	123.5	100	1,960.0	1,960.00
644	Nagsayang Pula	Tayabas	110	124	100	2,020.0	2,020.00
1179	Piniling	Nueva Ecija	115	133	90.9	1,430.1	1,299.96
724	Putyucanon	Leyte	107	127	83.3	2,401.0	1,999.03
1152	Bangol	Nueva Ecija	108	130.5	100	1,640.0	1,640.00
1303	Binoguinguin	Samar	105	130.5	90.9	880.1	800.01
1367	Colapdos	Oriental Negros	109	130.5	71.4	1,330.5	949.98
229	Calonod		99	130.5	100	820.0	820.00
1284	Guinaboc		123	134.5	83.3	1,439.4	1,199.02
574	Maliro	Leyte	92	127.5	76.9	2,179.3	1,675.88
774	Sacsek		87	132	78.9	1,730.8	1,330.99
306	Catorza	Iloilo	102	137.5	90.9	1,386.1	1,259.96
1231	Nagoyon	Batangas	115	130.5	83.3	1,800.7	1,469.98
530	Macan Piña	Nueva Ecija	73	139.5	76.9	1,560.5	1,199.92
47	Barangcal	Antique	111	141.5	100	1,060.0	1,060.00
92	Binicol I	Laguna	103	130.5	83.3	600.2	479.97
1301	Bihoralog Pula	Samar	83	137	90.9	1,804.2	1,640.02
1146	Casulig	Occidental Negros	117	132	90.9	2,240.3	2,036.43
619	Minantica Pilit	Leyte	102	130	83.3	1,775.5	1,478.99
970	Cayangkang	Occidental Negros	87	135	90.9	1,517.1	1,379.04
1089	Diquet a Pinasagad	Pangasinan	111	138.5	100	1,040.0	1,040.00
1213	Inagsaya	Batangas	94	125	83.3	1,584.6	1,319.87
1166	Kinandang Kumpol	Rizal	94	135.5	66.7	1,789.1	1,193.33
971	Kinastaño II	Batangas	106	129	83.3	2,231.6	1,889.92
1564	Malagkit	Rizal	120	131	83.3	1,169.3	974.02
1226	Mangasa	Nueva Ecija	113	137	90.9	1,012.1	920.00
1178	Piatan	Bontoc	108	81.5	90.9	1,100.1	999.99
1387	Pinalenke	Occidental Negros	99	134	83.3	576.2	479.97
1566	San Fabian		112	134	90.9	1,056.1	959.99
1148	Tuhao or Caot	.....do	117	126.5	83.3	1,500.3	1,250.00
1149	Bagsang	Nueva Ecija	97	124.5	66.7	5,217.4	3,480.00
1073	Calibug	Occidental Negros	86	134.5	71.4	1,876.7	1,339.96
254	Capichola		102	134.5	100	760	760.00
936	Inanod	Cavite	110	131.5	90.9	1,232.1	1,119.98
951	Kalibod		75	134.5	66.7	1,724.1	1,149.96
1324	Kinacao	Bulacan	98	139.5	83.3	722.7	602.01
1325	Kinayabong	Oriental Negros	85	138	83.3	624.2	519.96
1103	Lubang Blanco	Occidental Negros	91	136	71.4	1,568.8	1,120.12
1500	Macapno		84	130	83.3	384.1	295.96

[c] In very poor condition.

TABLE X.—*Variety test of upland rice at La Carlota Experiment Station for the year 1921*—Continued

Permanent No.	Variety name	Source	Height of plants at maturity	Age of plants at maturity	Actual per cent of plants harvested	Computed yield per hectare 100 per cent stand	Actual yield per hectare
			Cm.	*Days*		*Kilos*	*Kilos*
987	Magdalena	Tarlac	69	138	90.9	1,185.9	1,077.98
1110	Mangasa	do.	67	121.5	90.9	2,085.7	1,895.90
1111	Mayoro II	Occidental Negros	99	139	90.9	7,910.7	7,190.83
1117	Minantica IV	Nueva Ecija	88	136.5	71.4	1,000.8	714.57
673	Piniling Baybay	Rizal	108	138.5	100	1,140.0	1,140.00
815	Sinacoban	Oriental Negros	80.3	138.5	59.1	1,284.3	759.02
1254	Nangso	Siam	(c)	(c)	(c)	(c)	(c)
1258	Tadung	Saigon	(k)	(k)	(k)	(k)	(k)
1263	For Dung Bap	do.	(k)	(k)	(k)	(k)	(k)
35	Balibod	Tayabas	96.5	135	47.5	2,310.0	1,097.25
1482	Pinili	Iloilo	83	(d)	(d)	(d)	(d)
269	Capotol II	Oriental Negros	94	133.5	50.8	467.4	237.44
855	Tapol III	do.	110	133.5	90.9	85.8	77.99
1351	Oyoy	Capiz	85.8	151.6	90.9	1,408.1	1,277.96
1299	Bayangbang	Tayabas	83	131.5	66.7	1,679.1	1,119.96
1488	Casogsong	.....	100.1	146	32.7	1,118	365.59
1230	Naglihim	Batangas	94.8	153.5	100	168.0	168.00
1006	Palongpong	Misamis	99	137.5	91.9	1,738.5	1,597.68
1311	Carabao	Baao	(b)	(b)	(b)	(b)	(b)
1327	Kinilay	Oriental Negros	77.8	135.5	90.9	.....	.....
613	Mayoro I	.....	85.8	141	62.5	2,204.9	1,378.06
620	Minantica	.....	(d)	(d)	(d)	(d)	(d)
1348	Cadidi	Capiz	86	150	83.3	1,056.4	879.98
1350	Araw	do.	98.9	150	76.9	1,105.3	849.98
1247	Khao Bai Sri	Siam	81	(e)	(e)	(e)	(e)
959	Magpile	Rizal	(f)	(f)	(f)	(f)	(f)
338	Dali	Baao	(f)	(f)	(f)	(f)	(f)
1001	Apostol	Batangas	91.9	163.5	100	800	800.00
1246	Siamese Rice	Siam	(g)	(g)	(g)	(g)	(g)
1248	Kathisod	Saigon	(g)	(g)	(g)	(g)	(g)
1249	Nang Lorng	do.	(g)	(g)	(g)	(g)	(g)
1250	Thul Chalong	do.	(h)	(h)	(h)	(h)	(h)
1256	Nang Meo	do.	(i)	(i)	(i)	(i)	(i)
1255	Ramie	do.	(j)	(j)	(j)	(j)	(j)
1257	Ramay	do.	(j)	(j)	(j)	(j)	(j)
1252	Phung Tiey	do.	(k)	(k)	(k)	(k)	(k)
1262	Hue Ky	do.	(l)	(l)	(l)	(l)	(l)
1253	Bong Dua	do.	(m)	(m)	(m)	(m)	(m)
945	Catalong	Oriental Negros	110.3	140.5	100	1,370.0	1,370.00

[c] In very poor condition.
[d] White heads were produced due to rats, atangia, and birds.
[e] White grains only produced.
[f] In poor condition; flowering December 5.
[g] In very poor condition; flowering December 5.
[h] In fair condition; flowering December 5.
[i] In fair condition; in flowering December 9.
[j] In very poor condition; flowering December 8.
[k] In very poor condition; flowering December 9.
[l] In fair condition; flowering December 9.
[m] In very poor condition; rats ate grains as they were formed.

STUDY OF THE METHODS OF KEEPING SEED PALAY

This experiment was begun November 21, 1920. The varieties used were as follows: 1001 Apostol (harvested November 9, 1920); 1003 Lubang Blanco (harvested November 9, 1920); 1111 Mayoro II (harvested October 11, 1920); and 1148 Tuhao or Caot (harvested October 25, 1920). Five gantas of each of these varieties were placed in each of the following containers: baskets, seed cans, and gunnysacks. A regular bundle of heads of each of the varieties was hung up. For every set of contain-

ners a check was provided. One half ganta of powdered wood ashes was put on top of the seeds contained in cans and baskets. No treatment was applied to the hanging bundles, those in sacks and the check. 50 seeds were taken at random from each container. A germinating test was made once a month in seed flats.

Table XI shows the data obtained:

Container	Percentage of germination: December 16, 1920	Percentage of germination: November 24, 1921	Percentage loss of viability from December 16, 1920 to November 24, 1921
Cans	90.7	27.0	63.7
Bundles	78.0	23.0	55.0
Sacks	93.0	44.6	48.4
Baskets	90.0	45.5	44.5

The above data show that a basket is the best container for keeping seed palay, if placed where rats cannot reach it. The respiration of seeds in a can cannot escape so moisture forms in the can. This moisture makes a good medium for fungus growth.

OBSERVATION ON THE VIABILITY OF THE DIFFERENT VARIETIES OF UPLAND RICE

This experiment was started November 21, 1920. The varieties used were Inantipolo II, Lubang, Macan II, Macatibos I, Mayoro II, Daliket or Sanglay, Buluhan, Tuhao or Caot, Sanglay Puti, Kinastila V. Five gantas of each of these varieties were placed in sacks and hung up out of the reach of rats. Quarterly germination tests were performed from the first test for 9 months; monthly thereafter.

The data obtained are shown in Table XII:

Permanent No.	Variety name	Date of harvest (1920)	Percentage of germination						
			December 16, 1920	February, 1921 (3 mo.)	May, 1921	August, 1921	September, 1921	October, 1921	November, 1921
956	Inantipolo II	October 27	83	83	80	60	50	45	10
1103	Lubang Blanco	November 9	75	75	75	30	26	22	27
1049	Macan II	October 22	95	94	92	40	30	28	4
958	Macatibos I	August 21	95	95	90	20	18	15	10
1111	Mayoro II	October 11	97	82	82	60	56	52	30
966	Daliket or Sanglay	October 27	93	86	86	55	53	52	7
983	Buluhan		92	84	84	30	27	24	9
1148	Tuhao or Caot	October 25	95	78	78	20	19	10	15
791	Sanglay Puti	October 28	97	86	86	28	24	20	6
1050	Kinastila V		99	84	84	40	34	28	7

MONTHLY VARIETY TESTS

Table XIII shows the results obtained from the monthly variety tests of upland rice at La Carlota Experiment Station during the period 1920 to 1921.

Permanent No.	Variety name	Computed yield per hectare: First planting September 3, 1920	Second planting October 4, 1920	Regular season planting June 12-16, 1920	Remarks
		Kilos	*Kilos*	*Kilos*	
1001	Apostol	195.00	....	967.50	Same varieties planted in November 8 and December 5, 1920 and January 3, 1921 by same method did not produce crops.
78	Binagontauo	270.00	....	1,075.00	
1068	Bulao IV	50.00	80.8	870.00	
983	Buluhan	240.00	215.2	1,127.5	
966	Daliket or Sanglay	45.00	133.00	1,245.00	
362	Dinagat I	157.50	40.00	820.00	
956	Inantipolo II	40.00	....	1,200.00	
1048	Inintiw	272.5	....	1,337.50	
1049	Macan II	205.00	40.80	1,260.00	
958	Macatibos I	50.00	....	967.50	
1330	Naglihim	295.00	....	1,262.50	
574	Maliro	235.00	....	1,260.00	

From this table it can be seen that some early upland varieties can be grown with fair success during the month of September without artificial irrigation. Later than this date, planting is doomed to failure. The results in 1921 were no better than the preceding year's. It is therefore suggested that monthly planting like this had better be discontinued unless there are plenty of funds to properly finance the project for more years to get reliable results.

HEAD-TO-THE-ROW TEST

Only five varieties of high yielding upland rice, namely, 983 Buluhan, 966 Daliket or Sanglay, 956 Inantipolo II, 1103 Lubang Blanco, and 1049 Macan II were used in the test for 1921. Ten stocks composing five best heads were planted in separate rows. Close observation was made of the different rows of the different varieties.

Table XIV shows some of the important characteristics and the performance of each row.

TABLE XIV.—*Head-to-the-row test of upland rice at La Carlota Experiment Station for the year 1921*

BULUHAN

Row No-	Percentage of stand	Number of culms per plant	Percentage of bearing culms	Length of culms	Racemes: Length	Racemes: Number of spikelets	Racemes: Number of grains	Actual yield per row	Yield corrected according to rate of stand: Per row	Yield corrected according to rate of stand: Per hectare	Yield at 100 per cent stand: Per row	Yield at 100 per cent stand: Per hectare
				Cm.	*Cm.*			*Kilos*	*Kilos*	*Kilos*	*Kilos*	*Kilos*
1–1 [a]	80.4	6	83.3	71.7	20.1	10	97	1.9215	1.8499	924.95	2.39	1,195.0
1–2 [a]	96.0	5	100.0	71.7	23.0	10	89	2.3520	1.8963	948.15	2.45	1,225.0
1–3 [a]	96.0	5	82.0	77.7	17.2	9	92	1.7760	1.3932	696.60	1.80	900.0
1–4 [a]	68.0	6	100.0	77.4	26.4	9	81	1.9360	2.1672	1,083.60	2.80	1,400.0
1–5 [a]	58.0	5	82.0	73.4	17.9	9	75	.9686	1.2663	633.15	1.636	818.0
2–1 [a]	100.0	6	83.3	63.6	19.2	8	69	2.6260	2.0325	1,116.25	2.626	1,313.0
2–2 [a]	100.0	5	100.0	64.1	19.5	8	80	2.4017	1.7589	879.45	2.4017	1,200.85
2–3 [a]	100.0	5	100.0	68.1	19.3	7	90	2.2875	1.7705	885.25	2.2875	1,143.75
2–4 [a]	78.0	5	80.0	68.1	15.4	10	34	1.3376	1.3273	663.60	1.7149	857.45
2–5 [a]	62.0	5	100.0	64.0	16.7	10	36	.9036	1.1487	574.35	1.4574	728.7
3–1	64.0	6	83.3	60.7	17.9	11	46	.1347	.1625	81.25	.21	105.0
3–2	70.0	5	80.0	62.6	15.8	10	38	.0929	.1006	50.30	.13	65.0
3–3	74.0	5	100.0	65.1	15.7	9	33	.0800	.0851	42.55	.108	54.0
3–4	74.0	5	82.0	57.9	15.4	10	34	.0973	1.0139	506.95	1.31	655.0
3–5	42.0	4	100.0	59.3	14.7	11	37	.0630	.0010	58.10	.15	75.0
4–1	80.2	5	82.0	59.8	16.4	10	36	.1783	.1703	85.15	.22	110.0
4–2	80.4	6	83.3	54.9	15.4	9	30	.1178	.1161	58.05	.15	75.0
4–3	80.2	5	82.0	56.4	15.9	9	41	.0580	.0549	26.10	.07	35.0
4–4	68.0	4	100.0	56.9	19.4	9	42	.0580	.0464	23.20	.86	430.0
4–5	58.0	4	88.9	55.8	16.1	10	40	.0470	.0619	30.95	.08	40.0
5–1	100.0	4	75.0	54.6	15.8	11	42	.1330	.1625	81.25	.233	115.50
5–2	86.0	4	100.0	65.4	17.0	12	38	.1176	.1084	54.20	.14	70.0
5–3	80.2	5	100.0	55.1	16.9	9	39	.2581	.2478	123.90	.32	160.0
5–4	88.0	5	100.0	68.5	17.0	8	36	.1884	.1703	85.15	.22	110.0
5–5	78.0	5	100.0	58.7	17.3	9	37	.1802	.1935	96.75	.25	125.0
6–1	66.0	4	100.0	63.6	16.2	10	38	.1315	.1471	73.55	.19	95.0
6–2	94.0	5	100.0	63.8	16.8	11	33	.2275	.1858	92.90	.24	120.0
6–3	88.0	4	100.0	64.1	16.7	8	33	.2339	.2089	104.45	.27	135.0
6–4	52.0	4	100.0	60.6	15.1	9	34	.1097	.1625	63.25	.21	105.0
6–5	76.0	3	100.0	60.6	13.3	9	34	.1290	.1316	65.80	.17	85.0
7–1	76.0	4	100.0	51.7	15.2	10	27	.1025	.1006	50.32	0.13	65.0
7–2	100.0	4	100.0	55.8	15.1	10	39	.1596	.1238	61.90	.16	80.0
7–3	100.0	5	100.0	52.8	15.8	9	35	.3204	.2417	123.55	.32	100.0
7–4	78.0	4	100.0	52.7	16.2	9	35	.0756	.7740	28.70	.10	50.0
7–5	56.0	3	100.0	56.7	13.1	9	42	.0582	.7740	38.70	.10	55.0
8–1	50.0	3	100.0	52.3	16.9	9	33	.1037	.1006	50.50	.13	65.0
8–2	100.0	5	100.0	57.2	17.9	9	37	.2455	.1935	96.75	.25	125.0
8–3	88.0	4	100.0	59.6	17.8	9	38	.1205	.1161	11.65	.15	75.0
8–4	96.0	4	100.0	58.9	17.2	9	36	.1855	.1471	73.55	.19	95.0
8–5	72.0	3	100.0	59.6	16.8	8	37	.0990	.1080	54.20	.14	70.0
9–1	72.0	4	100.0	55.8	16.3	8	34	.1571	.1703	85.15	.22	100.0
9–2	80.4	5	83.3	61.2	14.5	8	38	.2984	.2874	143.70	.37	185.0
9–3	92.0	5	100.0	58.2	16.0	9	35	.1669	.2477	123.85	.32	180.0
9–4	72.0	4	100.0	55.5	15.9	10	39	.1300	.1393	69.65	.18	90.0
9–5	74.0	4	100.0	58.8	16.6	8	22	.1917	.1992	99.60	.26	130.0
10–1	26.0	5	100.0	54.9	14.8	9	37	.1285	.3793	189.65	.49	345.0
10–2	62.0	4	100.0	49.4	14.7	10	39	.1674	.3793	189.65	.49	245.0
10–3	70.0	4	100.0	55.2	15.7	9	35	.2064	.1245	62.25	.29	145.0
10–4	28.0	4	100.0	53.5	16.5	9	37	.0501	.1393	69.65	.18	90.0
10–5	100.0	4	100.0	51.8	16.2	10	41	.2822	.3167	108.35	.28	140.0
Rate	77.4	....	......	......	......	....	....	....	....	....	......	....

[a] Selected rows.

TABLE XIV.—*Head-to-the-row test of upland rice at La Carlota Experiment Station for the year 1921*—Continued

DALIKET OR SANGLAY

Row No.	Percentage of stand	Number of culms per plant	Percentage of bearing culms	Lengths of culms	Racemes			Actual yield per row	Yield corrected according to rate of stand		Yield at 100 per cent stand	
					Length	Number of spikelets	Number of grains		Per row	Per hectare	Per row	Per hectare
				Cm.	*Cm.*			*Kilos*	*Kilos*	*Kilos*	*Kilos*	*Kilos*
1-1 [a]	82.0	5	93.4	66.3	18.4	11	68	2.0500	1.8105	925.25	2.55	1,275.0
1-2 [a]	56.0	6	87.5	66.1	20.3	12	70	1.6800	2.1200	1,065.00	3.00	1,500.0
1-3 [a]	12.0	3	92.3	71.6	19.6	8	82	.2280	1.3490	694.50	1.90	950.0
1-4 [a]	20.0	3	91.9	71.0	17.2	9	40	.3000	1.0650	532.50	1.50	750.0
1-5 [a]	90.0	3	90.8	71.5	15.7	10	41	1.1475	.9017	450.85	1.27	635.0
2-1	100.0	4	90.6	68.5	18.2	9	39	.2700	.1917	95.85	.27	135.0
2-2	90.0	4	85.5	65.4	21.2	9	39	.3465	.2627	131.35	.37	185.0
2-3	42.0	4	88.2	68.1	20.4	11	87	.6300	1.0450	532.50	1.50	750.0
2-4	42.0	3	88.1	67.2	18.9	9	39	.1386	.2243	112.15	.33	165.0
2-5	100.0	4	94.4	62.6	16.4	9	38	.1950	.7420	71.00	1.95	97.5
3-1 [a]	74.0	3	95.4	62.5	18.3	10	52	1.1190	.1072	53.60	1.51	755.0
3-2 [a]	80.0	3	94.9	54.8	19.2	10	61	1.3200	1.7920	53.66	1.52	760.0
3-3 [a]	80.0	4	88.8	66.5	18.7	10	98	1.4400	.1278	63.90	1.80	900.0
3-4 [a]	48.0	4	94.8	68.9	20.9	10	57	1.1520	.7040	852.00	2.40	1,300.0
3-5 [a]	52.0	4	94.7	82.4	23.0	11	95	1.0400	.4200	710.00	2.00	1,000.0
4-1	82.0	4	89.6	79.1	20.4	12	78	.4018	.3479	178.95	.49	245.0
4-2	54.0	4	93.6	71.1	18.2	9	50	.1620	.2180	26.50	.30	15.0
4-3	96.0	4	97.7	79.8	19.1	10	58	.2722	.1998	29.40	.28	140.0
4-4	86.0	3	92.8	72.1	19.4	11	78	1.0220	.8449	42.45	1.19	595.0
4-5	100.0	2	90.9	67.8	17.4	9	41	.7000	.0497	24.85	.70	350.0
5-1	60.0	3	75.0	68.8	20.7	10	47	.6750	.7023	351.15	1.13	565.0
5-2	68.0	4	90.0	68.0	20.5	10	42	.4750	.1970	248.00	.70	35.0
5-3	70.0	3	85.4	68.0	20.9	10	61	.7560	.7668	383.40	1.08	540.0
5-4	76.0	4	94.3	70.6	17.9	11	117	1.2920	.1207	60.35	1.70	850.0
5-5	52.0	5	92.3	72.4	18.2	9	41	.9100	1.2425	621.25	1.75	875.0
6-1	98.0	5	92.3	70.0	19.2	11	51	.3720	.2698	134.90	.32	190.0
6-2	98.0	4	92.0	82.1	18.6	10	47	.3969	.3195	159.75	.45	225.0
6-3	100.0	5	92.6	66.7	18.4	10	45	.3150	.2272	113.60	.32	160.0
6-4	90.0	4	96.6	66.7	19.3	10	54	.3960	.3124	156.20	.44	220.0
6-5	90.0	5	90.2	78.0	15.2	8	42	.3735	.2982	149.10	.42	745.0
7-1 [a]	92.0	6	96.4	72.2	18.7	8	57	2.0160	1.5549	777.45	2.19	1,095.0
7-2 [a]	65.0	5	92.2	79.3	17.3	10	45	1.0230	1.1005	550.25	1.15	775.0
7-3 [a]	100.0	5	96.1	77.1	18.0	9	43	2.0000	.1420	71.00	2.00	1,100.5
7-4 [a]	50.0	6	100.0	78.7	17.5	9	41	1.4700	1.4910	745.50	2.10	105.0
7-5 [a]	56.0	5	98.8	73.3	18.1	9	44	.9800	1.2425	621.25	1.75	875.0
8-1	64.0	8	97.0	65.5	17.4	9	42	.2368	.2627	131.35	.57	185.0
8-2	100.0	6	98.4	74.0	17.0	9	47	.4565	.3266	171.10	.46	230.0
8-3	62.0	4	98.9	68.6	17.4	10	49	.2108	.2414	120.70	.34	170.0
8-4	76.0	4	91.5	70.1	18.3	10	50	.3420	.3195	159.75	.45	225.0
8-5	92.0	5	91.7	70.7	16.7	9	44	.7094	.5467	273.35	.77	385.0
9-1	92.0	4	98.7	70.5	16.7	6	40	1.0000	.7739	386.95	1.09	545.0
9-2	68.0	4	95.2	77.8	18.2	10	43	.2698	.2840	142.00	.40	200.0
9-3	74.0	4	94.3	62.5	18.2	9	41	.2886	.2769	138.45	.39	195.0
9-4	68.0	5	91.6	63.0	17.4	9	43	.4080	.4260	213.00	.60	300.0
9-5	76.0	4	100.0	60.0	17.9	10	52	.3648	.3408	170.40	.48	240.0
10-1	54.0	5	97.2	60.4	18.0	9	42	.1512	.1988	99.40	.28	140.0
10-2	40.0	3	90.2	55.4	17.7	9	42	1.0000	.1775	88.75	.25	125.0
10-3	48.0	4	95.9	60.5	15.9	9	44	.1272	.1917	95.35	.27	135.0
10-4	94.0	5	99.0	61.2	17.4	9	43	.3384	.2485	124.25	.35	175.0
Rate	71.0											

[a] Selected rows.

TABLE XIV.—*Head-to-the-row test of upland rice at La Carlota Experiment Station for the year 1921*—Continued

INANTIPOLO II

Row No.	Percentage of stand	Number of culms per plant	Percentage of bearing culms	Length of culms	Racemes: Length	Racemes: Number of spikelets	Racemes: Number of grains	Actual yield per row	Yield corrected according to rate of stand: Per row	Yield corrected according to rate of stand: Per hectare	Yield at 100 per cent stand: Per row	Yield at 100 per cent stand: Per hectare
				Cm.	*Cm.*			*Kilos*	*Kilos*	*Kilos*	*Kilos*	*Kilos*
1–1 [a]	56.0	9	98.1	88.2	22.3	15	114	7.0560	6.2496	3,124.80	12.6	6,300.0
1–2 [a]	15.0	5	97.1	80.1	21.4	14	122	.6750	2.2320	1,116.00	4.5	2,250.0
1–3 [a]	55.0	6	97.1	78.4	21.3	17	127	6.2700	5.6544	2,827.20	11.4	5,700.0
1–4 [a]	56.0	3	96.3	84.4	27.2	15	94	2.7720	2.2766	1,138.30	4.59	2,295.0
1–5 [a]	40.0	6	88.0	84.8	21.5	17	120	4.8000	5.9520	2,976.00	12.0	6,000.0
2–1 [a]	67.0	3	94.7	80.8	21.1	13	63	4.0200	2.9760	1,488.00	6.0	3,000.0
2–2 [a]	61.0	3	95.0	81.4	20.5	14	109	1.0980	.8928	446.400	1.8	900.0
2–3 [a]	52.0	3	67.3	84.4	22.0	15	98	1.5600	.4880	744.00	3.0	1,500.0
2–4 [a]	59.0	3	63.5	89.4	22.2	16	92	.3894	.2274	113.70	.66	330.0
2–5 [a]	67.0	3	61.9	82.0	21.0	15	119	3.2160	.4061	203.05	4.23	2,115.0
3–1 [a]	57.0	3	64.5	83.3	22.6	16	106	3.4200	2.9760	1,488.00	6.00	3,000.0
3–2 [a]	48.0	3	48.3	81.3	21.8	15	98	1.7280	1.7856	892.80	3.60	1,800.0
3–3 [a]	46.0	3	46.2	81.6	23.6	15	98	2.8980	3.1248	662.40	6.30	3,150.0
3–4 [a]	61.0	4	70.6	80.6	22.3	13	147	3.4160	2.6776	1,338.80	5.60	2,800.0
3–5 [a]	46.0	3	31.1	79.9	22.3	15	103	2.5492	2.0733	1,035.65	4.18	2,090.0
4–1	59.0	2	74.5	74.8	18.3	17	113	.4720	.4968	248.40	.80	400.0
4–2	68.0	3	49.2	80.2	21.1	14	93	1.2240	.9928	496.40	1.80	900.0
4–3	46.0	2	55.2	77.2	21.1	17	107	1.3800	1.4880	744.00	3.00	1,500.0
4–4	45.0	2	45.4	78.6	22.5	15	115	.4500	.4960	248.00	1.00	500.0
4–5	43.0	2	35.9	82.1	25.4	17	99	.5875	.6190	309.50	1.25	625.0
5–1	46.0	2	35.0	76.1	21.6	16	80	.8740	.9226	461.30	1.86	930.0
5–2	37.0	2	38.2	75.8	19.8	15	75	.7400	.9920	100.00	2.00	1,000.0
5–3	46.0	2	45.7	80.1	24.2	14	111	1.0020	1.8852	917.60	3.70	1,850.0
5–4	31.0	2	34.1	78.3	21.9	15	101	1.0230	1.6368	818.40	3.30	1,650.0
5–5	35.0	2	39.1	72.1	22.3	15	109	1.0200	1.4434	721.70	2.91	1,455.0
6–1	66.0	2	41.7	67.2	22.8	15	89	1.0022	.8283	414.15	1.67	835.0
6–2	39.0	3	44.0	74.3	21.7	20	105	1.0700	.2389	119.45	2.49	1,245.0
6–3	39.0	2	24.1	73.2	21.5	17	105	1.0920	1.4888	744.40	2.80	1,400.0
6–4	77.0	2	40.1	78.7	23.6	16	107	1.0400	.6351	317.55	1.48	740.0
7–1	45.0	2	41.7	69.4	22.4	15	94	.9000	.9920	496.00	2.00	1,000.0
7–2	27.0	2	25.0	75.0	23.4	13	396	.6750	1.2400	690.00	2.50	1,250.0
7–3	52.0	2	44.5	78.4	21.6	16	122	1.4400	1.3739	686.95	2.77	1,385.0
7–4	31 0	2	26 1	81 8	21 6	15	134	1.0230	1.6368	818.40	3.30	1,650.0
7–5	47 0	2	46 9	82 9	22 6	14	94	.7050	.7440	372.00	1.50	750.0
8–1	52 0	2	36 8	84 4	21 6	16	121	.6916	.5654	282.70	1.14	570.0
8–2	38 0	3	36 8	74 7	19 7	12	121	1.6110	1.3194	659.70	2.66	1,330.0
8–3	67 0	3	33 3	77 4	21 0	14	92	1.4137	1.0460	523.30	2.11	1,550.0
8–4	68 0	3	39 0	77 7	20 9	16	104	.8560	.6250	312.50	1.26	630.0
9–1	70.0	2	34.5	88.6	22.4	13	98	1.0500	.7440	372.00	1.50	750.0
9–2	72.0	2	27.7	75.9	21.8	16	125	1.0200	.7043	352.15	1.42	710.0
9–3	60.0	2	16.3	78.8	21.6	14	87	1.6500	1.3888	694.40	2.80	1,400.0
9–4	39.0	2	30.0	75.2	20.6	14	89	.7020	.9928	496.40	1.80	900.0
9–5	34.0	3	35.6	72.6	21.8	15	98	.8160	1.1904	595.20	2.40	1.200.0
10–1	85.0	2	36.1	77.6	20.6	16	120	2.5500	1.4880	744.00	3.00	1.500.0
10–2	47.0	3	39.4	78.5	19.6	16	116	.5280	1.1904	595.20	2.400	1.200.0
10–3	48.0	2	30.0	77.1	20.9	11	95	.8160	.7432	371.60	1.70	850.0
10–4	33.0	1	44.5	75.5	23.0	11	80	.3300	.4960	248.00	1.00	500.0
10–5	71.0	2	51.0	76.6	21.2	15	106	1.7440	1.9744	987.20	2.40	1,200.0
Rate	49.6	....	......	......	......	....	....	....	....	....	......	....

[a] Selected rows.

TABLE XIV.—*Head-to-the-row test of upland rice at La Carlota Experiment Station for the year 1921*—Continued

LUBANG BLANCO

Row No.	Percentage of stand	Number of culms per plant	Percentage of bearing culms	Length of culms	Racemes			Actual yield per row	Yield corrected according to rate of stand		Yield at 100 per cent stand	
					Length	Number of spikelets	Number of grains		Per row	Per hectare	Per row	Per hectare
				Cm.	*Cm.*			*Kilos*	*Kilos*	*Kilos*	*Kilos*	*Kilos*
1-1	84.0	6	96.5	63.7	18.5	10	58	.6552	.4485	224.25	.78	390.0
1-2	92.0	6	94.7	78.1	17.2	8	45	1.0560	.6613	330.65	1.15	575.0
1-3	92.0	5	99.1	82.0	22.3	12	62	1.0560	.6613	330.65	1.15	575.0
1.4	26.0	3	100.0	78.2	18.8	11	52	.4050	.8655	432.15	1.54	770.0
1-5	42.0	5	94.6	78.4	19.2	11	55	1.0500	1.4375	718.75	2.50	1,250.0
2-1 [a]	62.0	6	95.1	83.1	19.4	13	57	2.1390	.2588	129.40	3.45	1,725.0
2-2 [a]	46.0	7	99.5	77.0	19.6	11	57	8.2200	4.0250	2,012.50	7.00	3,500.0
2-3 [a]	34.0	4	95.9	85.1	18.9	10	46	1.0800	2.0113	1,005.65	3.15	1,575.0
2-4 [a]	38.0	5	92.9	75.1	17.9	11	57	1.0450	1.5813	790.65	2.75	1,375.0
2-5 [a]	42.0	6	91.2	71.4	16.0	13	55	1.7010	2.3328	1,160.40	4.05	2,025.0
3-1	98.0	6	100.0	90.0	20.0	10	94	.8115	.4723	236.15	.82	410.0
3-2	58.0	5	100.0	67.5	17.2	10	67	.2175	.2185	109.25	.38	190.0
3-3	80.0	5	93.7	65.8	20.0	15	50	.7600	.5463	278.15	.95	475.0
3-4	58.0	5	99.2	79.4	17.8	11	56	.3335	.3335	166.75	.58	290.0
3-5	36.0	5	99.0	73.6	18.0	10	60	.9600	1.5352	767.60	2.67	1,335.0
4-1	76.0	8	98.8	70.1	17.9	19	76	.1540	.1650	82.50	.20	100.0
4-2	56.0	8	95.7	74.6	16.9	10	64	.3024	.3105	155.25	.54	270.0
4-3	44.0	7	96.4	72.1	15.1	11	58	.1131	.1495	94.75	.26	130.0
4-4	48.0	9	98.2	80.8	13.6	10	52	.2592	.3105	155.25	.54	270.0
4-5	34.0	8	96.4	67.9	16.5	10	43	.0867	.1505	75.25	.26	130.0
5-1 [a]	84.0	6	93.8	61.6	19.1	11	60	2.5200	1.7250	862.50	3.00	1,500.0
5-2 [a]	86.0	5	94.6	73.5	18.3	11	53	1.5050	1.0063	503.15	1.75	875.0
5-3 [a]	50.0	5	90.7	68.2	......	10	55	1.8300	2.1448	1,172.40	3.73	1,865.0
5-4 [a]	84.0	5	98.1	90.0	20.5	11	55	2.3100	1.5813	790.65	2.75	1,375.0
5-5 [a]	64.0	5	96.6	79.4	16.5	12	58	1.1200	.4313	215.75	1.75	875.0
6-1 [a]	90.0	7	90.9	82.4	14.8	11	68	2.2050	1.4087	704.87	2.45	1,225.0
6-2 [a]	82.0	6	95.2	76.5	21.8	13	77	1.4760	1.0350	517.50	1.80	900.0
6-3 [a]	76.0	6	77.7	73.4	18.4	10	50	2.5080	1.8975	948.75	3.30	1,650.0
6-4 [a]	92.0	5	92.3	73.2	18.4	9	48	1.6100	1.0063	503.13	1.75	875.0
6-5 [a]	78.0	5	97.0	72.9	17.6	9	48	1.5600	1.1500	575.00	2.00	1,000.0
7-1	100.0	4	97.4	83.4	18.8	8	49	.3500	.2013	100.65	.35	175.0
7-2	64.0	4	91.4	66.0	19.9	9	62	.5120	.4600	230.00	.80	400.0
7-3	16.0	4	97.2	76.8	18.9	10	57	.2100	.7532	376.60	1.30	650.0
7-4	48.0	8	94.0	72.1	17.3	10	56	.2904	.3508	175.40	.61	305.0
7-5	66.0	7	89.9	76.3	14.8	9	41	.2660	.2760	138.00	.48	240.0
8-1	92.0	4	94.3	71.1	19.1	9	55	.5704	.3565	178.25	.62	310.0
8-2	58.0	5	97.2	69.9	21.9	11	61	.2175	.2185	109.25	.38	190.0
8-3	52.0	4	97.8	72.3	19.4	9	51	.3048	.3278	163.90	.57	285.0
8-4	52.0	4	97.8	74.9	19.3	9	57	.1568	.1725	86.25	.30	150.0
8-5	86.0	5	95.2	75.6	19.2	11	58	.4300	.1725	86.25	.30	150.0
9-1	62.0	5	93.4	68.7	18.3	11	55	.9100	.2703	135.15	.47	735.0
9-2	56.0	9	99.4	69.3	18.2	11	69	.7400	.7590	379.50	1.82	660.0
9-3	44.0	5	99.1	67.7	19.3	11	49	.1770	.1313	215.65	1.75	875.0
9-4	46.0	4	96.8	62.7	19.0	10	52	.5220	.6900	345.00	1.20	600.0
9-5	70.0	4	96.1	66.8	17.9	10	61	.1750	.1438	71.90	.25	125.0
10-1	50.0	5	86.9	79.1	19.8	11	56	.1792	.2371	18.50	.36	180.0
10-2	46.0	5	93.2	69.1	17.7	10	54	.1206	.1553	77.65	.27	135.0
10-3	32.0	4	94.9	66.3	18.3	10	48	.1560	.2819	140.95	.49	295.0
10-4	34.0	5	75.9	74.8	18.1	11	59	.4250	.7188	359.40	1.25	615.0
10-5	30.0	5	90.2	69.7	17.5	10	43	.4875	1.9315	465.75	1.62	810.0
Rate	57 5	....	......	......	......	....	....	....	....	....	......	....

[a] Selected rows.

TABLE XIV.—*Head-to-the-row test of upland rice at La Carlota Experiment Station for the year 1921*—Continued

MACAN II

Row No.	Percentage of stand	Number of culms per plant	Percentage of bearing culms	Length of culms	Racemes			Actual yield per row	Yield corrected according to rate of stand		Yield at 100 per cent stand	
					Length	Number of spikelets	Number of grains		Per row	Per hectare	Per row	Per hectare
				Cm.	*Cm.*			*Kilos*	*Kilos*	*Kilos*	*Kilos*	*Kilos*
1–1 [a]	92.0	5	98.8	61.5	17.1	9	34	2.0700	1.5930	796.50	2.25	1,125.0
1–2 [a]	78.0	6	93.0	67.3	16.0	9	38	2.2250	2.6550	1,327.50	3.75	1,875.0
1–3 [a]	80.0	4	94.4	65.7	20.0	9	65	1.6000	1.3160	708.00	2.00	1,000.0
1–4 [a]	92.0	6	91.5	64.1	20.2	9	54	2.4840	1.9116	955.80	2.70	1,350.0
1–5 [a]	74.0	4	97.7	68.1	19.4	11	49	1.1100	.1062	53.10	1.50	750.0
2–1	92.0	5	100.0	67.6	16.6	8	43	.6900	.5310	265.50	.75	375.0
2–2	88.0	4	100.0	63.7	15.7	8	40	.4140	.2698	134.90	.48	240.0
2–3	86.0	4	95.1	62.2	20.6	10	58	.4909	.4036	201.80	.57	285.0
2–4	62.0	4	98.9	63.5	16.5	9	71	.4960	1.5648	282.40	.80	400.0
2–5	50.0	4	97.5	61.4	16.8	8	46	.1500	.2124	106.20	.30	150.0
3–1 [a]	46.0	3	96.6	62.1	16.7	9	47	.5865	.9026	451.50	1.28	640.0
3–2 [a]	48.0	3	100.0	66.7	16.8	9	49	.5328	.7859	392.95	1.11	555.0
3–3 [a]	64.0	3	100.0	61.3	16.8	9	45	.8100	.8992	449.60	1.27	635.0
3–4 [a]	38.0	3	100.0	62.8	18.0	9	52	.3705	.6938	346.90	.98	490.0
3–5 [a]	46.0	4	100.0	66.8	16.8	9	47	.8464	1.3025	651.25	1.84	920.0
4–1	52.0	3	100.0	63.2	15.9	8	42	.3321	.4531	226.55	.64	320.0
4–2	60.0	4	100.0	63.7	18.5	10	57	.4500	.5300	275.00	.75	375.0
4–3	66.0	4	100.0	66.9	16.5	10	47	.5775	.6160	208.00	.87	440.0
4–4	44.0	3	98.5	60.9	15.2	11	53	.3300	.5310	265.50	.75	375.0
4–5	40.0	4	100.0	61.6	15.1	8	50	.7600	1.3452	662.70	1.90	950.0
5–1 [a]	82.0	3	100.0	63.1	20.0	9	53	1.8000	.6138	346.90	.98	490.0
5–2 [a]	76.0	3	100.0	60.3	17.7	9	39	1.7970	1.6709	835.45	2.36	1,180.0
5–3 [a]	60.0	3	100.0	61.8	17.3	9	50	1.2150	1.4302	715.10	2.02	1,010.0
5–4 [a]	96.0	3	98.7	68.2	16.9	10	49	1.9440	1.4337	1,216.85	2.03	1,015.0
5–5 [a]	90.0	3	99.0	62.5	15.8	9	45	1.3635	1.1162	158.10	1.52	760.0
6–1	38.0	4	96.2	62.3	16.5	9	58	.7980	1.4868	743.40	2.10	1,050.0
6–2	66.0	4	92.2	67.1	17.4	9	46	1.0880	1.1682	584.10	1.65	825.0
6–3	52.0	7	98.4	65.5	15.6	9	49	.3786	.5168	258.40	.73	365.0
6–4	66.0	3	100.0	64.5	15.4	9	51	.8910	.9558	477.90	1.35	675.0
6–5	50.0	4	87.5	66.5	17.2	8	51	.3625	.5168	258.40	.73	365.0
7–1	50.0	4	100.0	64.3	17.7	8	50	.7000	.9912	495.60	1.40	700.0
7–2	88.0	3	98.4	60.7	15.7	8	50	.9800	.7859	392.95	1.11	558.0
7–3	56.0	3	98.5	58.6	17.5	9	52	1.0000	1.2673	823.65	1.79	895.0
7–4	58.0	3	100.0	66.5	16.1	9	46	.9570	1.1682	534.10	1.65	825.0
7–5	74.0	3	94.3	55.9	18.7	11	53	.8325	.8000	400.00	1.13	565.0
8–1	62.0	4	100.0	55.6	17.3	11	56	1.0010	1.1824	591.20	1.67	835.0
8–2	84.0	2	93.9	54.5	16.1	9	43	.7140	.8434	421.70	1.05	525.0
8–3	68.0	3	100.0	50.9	16.6	8	50	.9180	.8071	403.55	1.14	570.0
8–4	80.0	3	100.0	60.3	14.6	8	56	.8400	.7734	371.71	1.05	725.0
8–5	80.0	3	100.0	53.0	17.1	11	54	1.0386	.8779	433.95	1.24	620.0
9–1	86.0	3	100.0	51.1	15.2	9	48	.4085	.3698	184.90	1.05	525.0
9–2	84.0	4	100.0	57.7	15.5	7	46	1.0680	.8992	449.60	1.27	635.0
9–3	24.0	3	100.0	58.4	14.8	8	45	.8000	.1092	53.10	1.50	750.0
9–4	56.0	4	100.0	52.7	16.2	8	54	.8400	.7062	53.10	1.13	750.0
9–5	34.0	3	100.0	51.5	16.3	9	52	.3825	.8000	400.00	1.13	565.0
10–1	66.0	4	100.0	48.2	14.7	8	44	.9900	1.0620	531.00	1.50	750.0
10–2	72.0	4	96.0	49.9	15.1	9	40	1.0296	1.0125	500.00	1.43	715.0
10–3	64.0	4	91.3	49.9	15.5	9	51	1.0152	1.1160	559.22	1.58	790.0
10–4	26.0	3	98.8	52.7	14.1	8	50	.2535	.6868	348.48	.97	485.0
10–5	50.0	5	97.7	55.3	15.2	8	42	.9990	1.4160	728.00	2.00	1,000.0

[a] Selected rows.

At the Alabang Rice Experiment Station a series of tests with a few selected varieties lasted from 1924 to 1926. The land used is typical of the fields planted to upland rice by the farmers in the district and is of the clay-loam type. A crop of rice was raised previous to the start of the work.

In 1924 the varieties Kinastila IV (980), Kinampupoy (1603), Inantipolo (956), and Binulagsak (1612) were tried. Seeds were sown on June 3. The crops were good, as may be seen from the following figures:

Variety name	Number of days to maturity	Yield per hectare in kilos
Kinastila IV	128	[a] 1,834
Kinampupoy	133	1,724
Inantipolo	130	923
Binulagsak	130	1,521

[a] 43.6 kilos of palay=one cavan.

The 1925 test included two additional varieties, viz.: the Apostol (1001) and Madaling Araw (1683); also a pure line named Rosario (1600) from Kinastila IV. The Binulagsak had been dropped on account of the undesirable size of the grain. Seeds were sown May 26–27, excepting those of the Apostol and Madaling Araw, which were sown June 9. The yields of palay per hectare and the time it took the different varieties to mature varied as follows:

Variety name	Number of days to maturity	Yield per hectare in kilos
Kinastila IV	142?	455
Kinampupoy	126	864
Inantipolo	135	470
Apostol	154	640
Madaling Araw	116	1,034
Rosario	135	901

In 1926 the Kinastila IV was discarded for the pedigree strain Rosario. Crops were planted about the same date as in 1925 and no important variation was noted in the growing and maturing period. The Balanac (168), a recent introduction from the Lamao Experiment Station, matured in 105 days.

The comparative yields were:

	Kilos
Apostol	805
Balanac	525
Inantipolo	569
Kinampupoy	1021
Rosario	714
Madaling Araw	1066

Difficulty in securing even stands for all the plots was experienced. This fact would make it inadvisable to bring to the

close this set of experiments with a group of varieties in a three year period. It suggests the necessity of regulating the seeding rate so as to conform more to the germinating power of each seed at the time of sowing than heretofore observed.

TABLE XV.—*Summary of variety tests of upland rice at La Carlota Experiment Station for the period 1916–1921*

Permanent No.	Variety name	Yield per hectare in kilos						Average yield per hectare
		1916	1917	1918	1919	1920	1921	
1966	Daliket or Sanglay	3,330	2,785	1,895	3,476.25	1,245	2,895.5	2,604.46
1050	Kinastila V	2,345	2,607.5	1,670	2,089.5	1,045	2,549.8	2,051.1
1051	Nagdami II	3,250	2,590	1,295	1,994.53	767.5	1,674.9	1,928.65
967	Binunduk II	2,570	2,332.5	1,220	2,118.47	1,337.5	1,064.0	1,773.74
971	Kinastaño	2,750	2,552.5	1,370	2,127.65	945	1,540.2	1,880.89
943	Bonguet	2,850	2,275	870	2,191.23	682.5	1,546.2	1,735.82
791	Sanglay Puti	2,455	2,830	1,245	2,150.2	1,227.5	1,556.6	1,910.7
951	Kalibod	2,633	2,670	1,245	2,221.1	1,380	1,724.1	1,978.8
724	Putyucanon	2,270	2,172.5	1,345	1,876.33	1,257.5	2,401.0	1,887.05
78	Binagontauo	1,458	1,700	1,820	1,477.54	1,075	2,266.2	1,632.79
574	Maliro	1,308	1,897.5	1,970	1,581.8	1,260	2,179.3	1,699.4
774	Sacsek	2,645	2,272.5	1,570	1,923.84	2,002.5	1,730.8	2,024.1
969	Binucaue	2,100	1,852.5	1,120	1,986.15	1,185	1,025.0	1,544.74
815	Sinacoban	2,820	1,677.5	1,520	2,048	782.5	1,284.3	1,688.7
92	Binicol I	2,108	2,330	1,620	2,268.5	1,542.5	600.2	1,744.8
619	Manteca Pilit or Minanteca Pilit	2,245	2,292.5	1,620	1,651.41	572	1,775.5	1,692.73
945	Catalong	2,820	2,890	1,570	1,889.1	....	1,370.0	2,107.8
126	Bulandi	2,158	2,440	1,545	1,520	697.5	1,748.1	1,684.7
956	Inantipolo II	2,445	2,625	1,120	1,610.77	1,200	2,300.0	1,883.46
936	Inanod I	1,770	1,967.5	1,270	1,490.64	982.5	1,232.1	1,452.12
983	Buluhan	3,050	2,650	1,770	3,067.25	1,127.5	1,656.0	2,220.12
988	Quinabebe II	2,450	....	....	....	....	....	2,450.0
47	Barangcal	2,470	2,795	1,770	2,296.35	405	1,060.0	1,799.39
987	Magdalena	1,770	2,530	1,570	2,062.5	1,152.5	1,185.9	1,878.4
980	Kinastila IV	2,910	2,767.5	1,295	2,241.4	1,277.5	2,681.4	2,195.4
998	Macarañag II	2,383	2,212.5	1,195	1,968.97	1,420	1,960.0	1,856.58
363	Dinagat II	2,150	2,305	1,670	2,129.95	622.5	1,413.7	1,715.19
999	Hinirang	2,745	2,422.5	1,170	2,744.92	1,760	1,043.2	1,980.93
1006	Palongpong	1,920	1,792.5	1,695	1,979.25	3,675.0	1,738.5	2,133.37
1062	Bebe	2,500	2,925	1,470	2,264.5	1,050	1,694.0	1,983.9
1068	Bulao IV	2,470	2,353	1,597.5	2,754.5	870	1,436.0	1,913.5
1073	Calibug	1,570	2,385	1,520	2,533.4	1,550	1,876.7	2,072.5
1089	Diquet a Pinasagad	1,055	1,117.5	920	2,256.91	780	1,040.0	1,194.9
1095	Guinarana	520	2,005	....	....	....	....	1,262.5
1048	Inintiw	1,420	1,570	2,070	2,833.5	1,337.5	704.1	1,655.8
1097	Initlog dalag	2,150	3,185	1,170	2,252.81	682.5	2,028.6	1,911.48
1100	Lampadan or Allañgigan	1,445	1,922.5	1,370	1,931	1,000	4,129.6	1,966.3
1101	Langauisan	1,720	1,950	1,370	2,576.86	1,492.5	2,497.0	1,934.39
1103	Lubang Blanco	1,738	2,737.5	1,670	3,241	1,342.5	1,568.8	2,049.6
1049	Macan II	2,413	2,230	1,870	3,155.7	1,260	2,016.0	2,157.4
1110	Mangasa II	1,695	3,270	1,495	3,155.5	1,365.0	2,085.7	2,177.7
1111	Mayoro II	1,670	1,920.5	1,670	2,198.62	675	....	1,626.82
1117	Minantica IV	2,420	2,252.5	1,120	1,804.82	1,175	1,000.8	1,628.85
1133	Samban	3,250	2,610	1,745	2,016.5	1,300	4,000.0	2,486.9
1138	Sinampaga	2,620	1,740	1,070	1,254.07	995	2,038.9	1,619.66
1136	Sinaba III	1,430	1,805	895	2,258.64	867.5	1,060.0	1,386.02
1146	Casulig	2,120	1,815	770	1,877.17	1,217.5	2,240.3	1,673.33
970	Cayangcang	2,070	1,450	1,145	1,578.79	1,285.0	1,517.1	1,507.65
1147	Cutsiam II	1,950	2,351	1,420	2,163.3	882.5	2,524.0	1,881.8
	Daliquit or Daliket (1558)	2,585	....	....	....	....	2,255.34	2,420.17
	Pinalengke (961)	1,320	1,745	920	1,901.2	....	....	1,471.5
1148	Tuhao or Calt	1,220	2,570	1,420	2,037.11	980	1,500.6	1,621.28
958	Macatibos	......	2,445	1,445	2,856.75	967.5	651.1	1,673.07
1125	Pinili a biit	......	1,807.5	1,495	2,433.88	427.5	619.0	1,356.57
362	Dinagat I	......	2,322.5	1,870	1,907.7	820.0	480.0	1,480.0
1166	Kinandang Kumpol	......	2,157.5	1,520	1,931.3	1,512.5	1,789.1	1,782.0
1181	Pol-lique	......	2,130	1,245	2,069.3	1,057.5	466.2	1,393.6
1184	Ugnas	......	2,095	1,020	2,037.15	1,032.5	1,555.2	1,547.97
718	Pulupot	......	1,937.5	1,120	1,698.5	1,557.5	1,760.2	1,614.7
1160	Cucuam	......	1,360	1,170	1,240.99	1,007.5	1,167.5	1,189.19
1161	Dinalaga (V)	......	1,900	1,645	1,892.7	1,001.5	1,620.6	1,611.9
1179	Piniling	......	1,475	920	1,306.5	1,165.0	1,430.1	1,259.3
1151	Bansuray	......	672.5	....	....	....	....	672.5
1152	Bangol	......	987.5	620	1,901.71	1,107.5	1,640.0	1,251.34

TABLE XV.—*Summary of variety tests of upland rice at La Carlota Experiment Station for the period 1916–1921*—Continued

Permanent No.	Variety name	Yield per hectare in kilos 1916	1917	1918	1919	1920	1921	Average yield per hectare
1153	Balolaki	......	922.5	....	....	....	....	922.5
1157	Bulik	......	1,232.5	....	....	....	....	1,232.5
1178	Piatan	......	2,065	970	2,112.8	1,297.5	1,100.1	1,509.0
1190	Miyako II	......	....	322.5	598.9	687.5	....	536.3
1188	Sekitori	......	....	120	1,155	1,105	2,697.7	1,269.4
1189	Takenari	......	....	67.5	....	730	2,056.4	951.3
1150	Balasang	......	....	1,320	2,234.1	1,392.5	503.6	1,362.5
979	Magpunit II	......	....	1,645	2,123.5	1,012.5	....	1,593.6
991	Malagkit Kaawa	......	....	1,120	1,694.72	....	....	1,407.36
1193	Kinastila VII	......	....	1,570	2,583.57	870	1,160.2	1,545.94
1158	Cammang	......	....	1,445	2,049.83	940	4,029.4	2,116.06
1001	Apostol	......	....	2,295	2,454.52	967.5	800.0	1,629.25
1149	Bagsang	......	....	745	1,747.85	1,125	5,217.4	2,208.81
1231	Nagoyon	......	....	1,120	1,992.44	1,102.5	1,800.7	1,503.91
1226	Mangara	......	....	1,170	1,804.42	1,270	1,012.1	1,314.13
1234	Piniling Bebay	......	....	1,270	1,503.12	915	2,378.8	1,516.73
1230	Naglihim	......	....	1,970	2,812.38	1,262.5	168	1,553.22
1215	Jap. Rice (no name)	......	....	42.5	....	91.25	....	66.87
1217	Kinandang Puti	......	....	1,745	3,136.92	1,387.5	3,106.8	2,344.05
1216	Kinandang Pula	......	....	1,470	3,185.47	812.5	1,120	1,646.99
1213	Inagsaya	......	....	1,467	1,976.5	1,140	1,584.6	1,542.0
1280	Chinese (First Crop) Glutinous Rice	......	....	....	562.6	1,500	....	1,031.3
1281	Chinese Autumn Crop Glutinous Rice	......	....	....	721.3	291	....	506.1
1246	Siamese Rice	......	....	....	....	992.5	....	992.5
1247	Khao Bai Sri	......	....	....	....	1,050	....	1,050.0
1248	Kathisod	......	....	....	....	470	....	470.0
990	Ka-awa	......	....	....	....	787.5	1,000	893.7
1564	Malagkit	......	....	....	....	565.0	1,169.3	867.1
1387	Pinalenke	......	....	....	....	1,090.0	576.2	833.1
1283	Minita or Menita (1185)	......	2,360	1,420	1,547	481	840.0	1,329.6
1346	Kinalangkang	......	....	....	....	592.5	944.5	768.5
1312	Capayong	......	....	....	....	805.0	1,064.4	934.7
1334	Pilit morado	......	....	....	....	1,295.0	1,400.5	1,347.7
1302	Binagacay	......	....	....	....	1,230	1,628.2	1,429.1
1288	Agsam	......	....	....	....	1,175	1,848.7	1,511.8
1237	Binalinting Famy	......	....	....	....	460	2,538.1	1,499.0
269	Capotol II	......	....	....	....	880	467.4	673.7
1309	Caña Bombo	......	....	....	....	462.5	1,648	1,055.25
1286	Minacan	......	....	....	....	502.5	1,800	1,151.25
1324	Kinacao	......	....	....	....	1,390	722.7	1,056.35
1330	Layag	......	....	....	....	625	1,736	1,180.5
1316	Dayome	......	....	....	....	367.9	2,521	1,444.4
1305	Cabayo	......	....	....	....	95	869.6	482.3
1343	Quinokong Uwak Sta. Maria	......	....	....	....	410.25	1,009.9	710.07
1319	Galong Sta. Maria	......	....	....	....	75	....	75,0
1285	Kinampupoy	......	....	....	....	553	728	640.0
448	Inaslom	......	....	....	....	195.75	1,195.1	695.42
1328	Malagayang Tapol	......	....	....	....	789.5	1,573.4	1,181.45
35	Balibod	......	....	....	....	112.5	2,310	1,211.25
282	Caririt	......	....	....	....	79.75	1,540.2	809.97
1320	Guinamat	......	....	....	....	630.5	1,938.3	1,284.4
1322	Guimat	......	....	....	....	407.0	2,367.2	1,387.1
1315	Danilog	......	....	....	....	319	1,784.1	1,051.5
1340	Unoy Dagoydoy	......	....	....	....	481	1,584.6	1,032.8
1367	Colapdos	......	....	....	....	321.75	1,330.5	826.12
1237	Binalintin	......	....	....	....	530	....	530.0
1338	Tapacoy	......	....	....	....	81	2,360	1,220.5
562	Malagaya	......	....	....	....	176.5	1,408.1	792.3
1344	Nagrion	......	....	....	....	156	812	484.0
1289	Amariles	......	....	....	....	245.5	2,907.5	1,576.5
254	Capichola	......	....	....	....	197.5	760	478.75
1323	Inacopanga	......	....	....	....	107.0	1,786.3	946.65
1348	Cadidi	......	....	....	....	490.5	1,056.4	773.45
338	Dali	......	....	....	....	357.5	....	357.5
1351	Oyoy	......	....	....	....	478	1,408.1	943.05
644	Nagsayang Pula	......	....	....	....	106.75	2,020	1,063.37
1299	Bayangbang	......	....	....	....	88.50	1,679.1	883.8
673	Piniling Baybay	......	....	....	....	170	1,140	655.0
1364	Binagontauo	......	....	....	....	127.65	1,824.7	976.17
855	Tapol III	......	....	....	....	648.75	85.8	367.27
520	Lubang Pula	......	....	....	....	669	2,054.5	1,361.7
879	Tinomanan	......	....	....	....	321	2,041.4	1,181.2

TABLE XV.—*Summary of variety tests of upland rice at La Carlota Experiment Station for the period 1916–1921*—Continued

Permanent No.	Variety name	Yield per hectare in kilos						Average yield per hectare
		1916	1917	1918	1919	1920	1921	
1325	Kinayabog					416.5	624.2	520.35
1331	Mita					62.5	1,239.2	650.85
1311	Carabao					558.25		558.25
1327	Kinilay					120.0		120.0
1301	Bihoralog Pula					370.75	1,804.2	1,087.47
1310	Caponguit					525.25	1,971.4	1,248.32
1329	Malagoso					436	1,789.9	1,112.95
12	Amayan					416.5	504.2	460.35
1337	Sarocot					505.75	1,530	1,017.87
1308	Caluis					742.5	1,444.2	1,093.35
1287	Oag-oag					334.5	1,372.8	853.6
1318	Galong-Famy					623.5	1,056.4	839.95
1332	Naglantik					485.5	996.4	740.95
1304	Binongang Loay or Binoguinguing Loay					185.2	1,403.1	794.15
1313	Carawin					227.5	2,064	1,145.75
1300	Berilhon					191.5	1,520.2	855.85
777	Sagoboy					295	1,000	647.5
65	Binabaye					265	861.0	563.0
1339	Tonguitan					153.75	1,368.3	761.02
1307	Cabon					645	2,788.5	1,716.75
1335	Quinirispinong Puti					312.5	1,196.4	754.45
1298	Ban-ar					324.5	1,421.3	872.9
1303	Binoguinguin					179	880.1	529.55
1047	Caviteña a Biit (1345)					484.5	890.5	687.5
530	Macan Piña					43.25	1,560.5	801.87
1342	Ngapol					216.5	1,716.7	966.6
1333	Luyot					220	1,210.1	715.05
1341	Buaoa					223.75	912.4	568.07
1314	Cuoab					220	2,148.3	1,184.15
572	Malido					126	3,040.0	1,583.0
1482	Pinili					82.5		82.5
306	Catorsa					43.5	1,386.1	714.8
120	Bulagsac I					349.75	1,760.1	1,054.92
1562	Kinastila					100.5	1,258.1	679.3
1489	Inantaka					188.75		188.75
1561	Lintang Anbod					122	1,914.12	1,018.06
1292	Early Prolific					35.55	1,050	542.77
1500	Macapno					672	384.1	528.05
1565	Kinamantigue					132.5	1,079.3	605.9
1490	Sinaria					220	1,494.2	857.1
1267	Carolina Gold					402.5	1,908.0	1,155.25
1386	Panay					460	2,645	1,552.5
515	Lubang II					457.5	973	715.25
933	Omachi						627.84	627.84
1358	Tamasuri						976.64	976.64
1353	Aikoku						278.4	278.4
1359	Urasan						279.04	279.04
1559	Cutsiam						1,208	1,208.0
1560	Buluhan						1,628	1,628.0
1290	Blue Rose I						1,522.1	1,522.1
1385	Guinatos						3,699.2	3,699.2
1357	Oba						2,000	2,000.0
1321	Guinanay						1,004	1,004.0
1326	Kinanda						2,496	2,496.0
1557	Kinanda II						887	887.0
1389	Cainte III						840	840.0
639	Nagdami						867.1	867.1
347	Dappog						1,259.3	1,259.3
261	Caporcas						2,778.7	2,778.7
1489	Minantica						1,580	1,580.0
229	Calonod						820	820.0
1284	Guinaboc						1,439.4	1,439.4
971	Kinastaño						2,231.6	2,231.6
1566	San Fabian						1,056.1	1,056.1
1488	Casogsong						1,118	1,118.0
613	Mayoro I						2,204.9	2,204.9
1350	Araw						1,105.3	1,105.3

SOME EXPERIMENTS ON TOBACCO IN THE EXPERIMENT STATION IN ILAGAN, ISABELA

Wrapper variety tests (*J1–11–16*).—In wrapper yield 43-Philippine-Sumatra (P. I. 8293) led with 35 per cent, followed by 65-Havanensis (P. I. 8610) with 15 per cent and 18-Philippine-Florida-Sumatra (P. I. 8714) with 10 per cent. In total yield, 43-Philippine-Sumatra also led with 1,690 kilos, followed by 18-Philippine-Florida-Sumatra with 1,649 kilos and 65-Havanensis with 1,235 kilos. For more detailed results, see Table I.

The seeds of all the varieties used were sowed on August 28, 1926, germinating September 10, and the seedlings were transplanted on November 11 with the exception of those of 65-Havanensis which were set out in the field November 20, 1926. The soil of the field used was silty loam. Owing also to variations in the relative sizes of the three varieties used in this experiment, the distancing was not uniform: 43-Philippine-Sumatra was set out 50 centimeters apart in alternate rows of 50 and 80 centimeters apart. The late germination was due to the fact that the beds used were open and only natural rainfall was depended upon for water, as also in the fields.

Acclimatization tests (*J2–11–16*.—Seven foreign varieties were used. Two varieties: 90-Java (P. I. 9352) and 79-N. T. Havanensis belong to the cigar wrapper type. Two also, 68-Tall Zimmer (P. I. 8996) and 69-Dutch (P. I. 8998), belong to the cigar filler type, and the rest, 29-Olsen No. 1 (P. I. 8726), 76-Kavalha (P. I. 9085), and 78-South African (P. I. 9112) belong to the Bright or Cigarette type. Their yields were, respectively, 150.1, 726, 1158, 1078, 706, 464, and 1,047 kilos per hectare. With the exception of the 79-N. T. Havanensis and the 76-Kavalha, the yields can be considered very good. 90-Java is apparently identical with our standard 43-Philippine-Sumatra and 29-Olsen No. 1 is identical with the standard Orinoco variety in the United States. For more detailed results, see Table II.

The seeds of all the varieties used in this experiment were sowed October 10, 1926, in wooden flats, germinating 5 to 7

days later, and the seedlings were all transplanted at the same time—December 23, 1926. The soil of the field used is technically silty loam also but with a tendency to be clay loam. The bigger varieties, 68-Tall Zimmer, 69-Dutch, and 29-Olsen No 1, were set out in the field 70 centimeters apart in rows 80 centimeters apart while the smaller varieties: 90-Java, 79-N. T. Havanensis, 76-Kavalha, and 78-South African were set out 50 centimeters apart in rows 80 centimeters apart also. Lime was applied to the field at the rate of 1,000 pounds per hectare, a month before planting.

General filler variety tests (J3–11–16).—Originally it was intended to use only 5 varieties in these tests, but because of fair showing of the 68-Tall Zimmer and the 69-Dutch in the acclimatization field, data on them are included in this experiment. 6-Pampano No. 2 (P. I. 8735) led in yield with 287.50 kilos per hectare, followed respectively by 10-Repollo (P. I. 8737) with 2,607 kilos, 17-Pampano No. 5 (P. I. 8742) with 2,507 kilos, 12-Pampano No. 1 (P. I. 8739) with 2,133 kilos, 68-Tall Zimmer (P. I. 8996) with 1,158 kilos, 69-Dutch (P. I. 8998) with 1,078 kilos and lastly, 36-Bahia (P. I. 7497) with only 528 kilos per hectare. For more detailed results, see Table III.

TABLE I.—*General wrapper variety test (Experiment J1—11—16)*

Plot No.	Area planted	P. I. No.	Station No.	Variety name	Stalk characters: Total height	Stalk characters: Middle circumference	Stalk characters: Middle internode length	Green leaf characters: No. standard leaves	Green leaf characters: Dimensions of middle standard: Average length	Green leaf characters: Dimensions of middle standard: Average width	Green leaf characters: Mean breadth index
	Hectare				*Cms.*	*Cms.*	*Cms.*		*Cms.*	*Cms.*	*Per cent*
1	.25	8293	43	Philippine Sumatra	207.20	6.21	7.48	19.34	45.86	24.72	55.95
2	.25	8714	18	Philippine Florida Sumatra	226.40	6.98	7.73	21.52	46.18	30.18	64.90
3	.125	8610	65	Havanensis	147.60	4.75	4.88	19.18	35.43	19.29	53.25
Check	1.00			Mixed native	147.70	6.38	6.26	19.68	42.49	18.95	40.60

Plot No.	Cured leaf characters: Color	Cured leaf characters: Aroma	Cured leaf characters: Color of ash	Cured leaf characters: Burning quality	Yield: Actual	Yield: Computed per hectare	Yield: Wrappers by weight
				Seconds	*Kilos*	*Kilos*	*Per cent*
1	Light brown	Fair	Gray	121	422.5	1,690	35
2	Dark brown	Poor	Dark gray	23	412.00	1,648	10
3	Brown	Fair	Gray	80	154.5	1,236	15
4	Mixed	Good	Mixed	30	1,324.00	1,324.00	2

TABLE II.—*Acclimatization test of Tobacco (Experiment J2-11-16)*

Plot No.	Area planted	P. I. No.	Station No.	Variety name	Stalk characters			Green leaf characters			
					Total height	Middle circumference	Middle internode length	No. standard leaves	Dimensions of middle standard		Mean breadth
									Average length	Average width	
	Hectare				*Cms.*	*Cms.*	*Cms.*		*Cms.*	*Cms.*	*Per cent*
1	.01	9352	90	Java	149.40	5.3	4.04	18.84	36.37	20.21	55.5
2	.01	....	79	N. T. Havanensis	96.60	3.8	4.44	13.68	25.12	15.14	57.7
3	.01	8996	68	Tall Zimmer	86.00	6.4	3.50	20.80	42.45	22.2	50.5
4	.01	8998	69	Dutch	90.40	6.64	4.70	20.36	38.36	19.36	49.6
5	.01	8726	29	Olsen No. 1	96.00	6.48	3.52	22.56	41.28	15.22	35.7
6	.01	9085	76	Kavalha	106.20	4.12	3.48	23.20	23.32	12.84	54.5
7	.01	9112	78	South African	82.25	3.97	3.77	30.80	23.7	12.06	49.87

Plot No.	Cured leaf characters				Yield		
	Color	Aroma	Color of ash	Burning quality	Actual	Computed per hectare	Wrappers by weight
				Seconds	*Kilos*	*Kilos*	*Per cent*
1	Light brown	Good	Gray	15	15.01	1,501.00	3
2	Dark brown	do	Dark gray	45	7.26	726.00	1
3	do	Fair	do	33	11.58	1,158.00	....
4	Brown	do	Gray	24	10.78	1,078.00	....
5	Dark brown	Good	do	40	7.06	706.00	....
6	Brown	Fair	do	10	4.64	464.00	....
7	Do	Good	do	11	10.47	1,047.00	....

TABLE III.—*General filler variety tests (Experiment J3-11-16)*

Plot No.	Area planted	P. I. No.	Station No.	Variety name	Stalk characters: Total height	Stalk characters: Middle circumference	Stalk characters: Middle internode length	Green leaf characters: No. standard leaves	Dimensions of middle standard: Average length	Dimensions of middle standard: Average width	Mean breadth index
	Hectare				*Cms.*	*Cms.*	*Cms.*		*Cms.*	*Cms*	*Per cent*
1	.23	8735	6	Pampano No. 2	266.40	8.62	6.08	31.16	59.41	30.87	57.85
2	.145	8737	10	Repollo	221.10	8.00	6.78	25.36	60.18	27.37	45.10
3	.01	8742	17	Pampano No. 3	144.83	5.36	5.36	23.33	43.52	16.77	43.08
4	.30	8739	12	Pampano No. 1	281.80	7.42	10.20	24.20	50.87	29.51	58.35
5	.01	8996	68	Tall Zimmer	86.00	6.40	3.50	20.30	42.45	22.20	50.50
6	.01	8998	69	Dutch	90.40	6.64	4.70	20.36	38.36	19.38	49.60
7	.01	7497	36	Bahia	93.00	4.70	5.60	10.00	36.70	20.65	55.50
Check	1.00	....	....	Mixed native	147.70	6.38	6.25	19.68	42.49	18.95	40.60

Plot No.	Cured leaf characters: Color	Cured leaf characters: Aroma	Cured leaf characters: Color of ash	Cured leaf characters: Burning quality	Yield: Actual	Yield: Computed per hectare	Yield: Wrappers by weight
				Seconds	*Kilos*	*Kilos*	*Per cent*
1	Dark brown	Fair	Gray	66	664.125	2,887.50	8
2	Brown	Good	do	68	378.015	2,607.00	6
3	Dark brown	do	Dark gray	34	25.07	2,507.00	12
4	Do	Fair	Gray	17	639.90	2,133.00	10
5	Do	do	Dark gray	33	11.58	1,158.00	....
6	Brown	do	Gray	24	10.78	1,078.00	....
7	Dark brown	do	do	12	5.28	528.00	....
8	Mixed	Good	Mixed	30	1,324.00	1,324.00	2

The seeds of 6-Pampano No. 2, 10-Repollo, and 12-Pampano No. 1 were sowed August 28, 1926, germinating September 10, and the seedlings were transplanted November 12, 1926. The seeds of the other varieties were sowed October 19, 1926, germinating 5 to 7 days later, and the seedlings were transplanted on December 23, 1926. All the seedlings were set out in the fields 70 centimeters apart in rows 80 centimeters apart, but while those of the first group (earlier planted) were in plots of typically silty loam soil, those of the second group were in plots of technically silty loam soil that was really more of a clay loam. The latter soil, however, was treated with an application of lime at the rate of 1,000 pounds per hectare a month before being planted.

General fertilizer tests (J5b–1–26).—The fertilizers used were ammonium sulphate, superphosphate, and sulphate of potash, applied singly or in double and treble combination. In all there were 42 plots of $\frac{1}{80}$ hectare each. The variety 43-Philippine-Sumatra was used. The best yield was obtained from plot 34 in which sulphate of potash alone was applied at the rate of 75 kilos of K_20 per hectare, and the lowest yield from plot 23 in which ammonium sulphate and superphosphate were applied at the rate of 20 kilos of N and 30 kilos of P_20_5, respectively, per hectare. For detailed results see Table IV. Table V gives the treatment of each plot, the kind of fertilizers used, the amount of the fertilizers applied, and the combination ratios.

The seeds of the variety used in this experiment were sowed September 20, 1926, germinating eight days later. The seedlings were transplanted December 19 and 20, 1926, 60 centimeters apart in rows 80 centimeters in each plot. For the arrangement of the plots see Plate I. The fertilizers were spread around the roots of the growing plants instead of being broadcasted over the entire plots.

It will be noted that the yields are relatively low, much lower than for the same variety in the regular wrapper variety tests. The reasons are: (1) the plants were set out a little farther apart, (2) they were planted late, and (3) the soil, although technically silty loam, was virtually clayey.

TABLE IV.—*Field fertilizer test*

[The size of each plot is 5 by 25 meters or 125 square meters or 1/80 hectare]

Plot No.	Treatment of plot	Total plant height	Green leaf characters		
			Number of standard	Dimensions of middle standard	
				Length	Width
		Cms.		*Cms.*	*Cms.*
1	Check	76.6	13.08	26.20	13.64
4	Do	70.5	10.69	23.36	11.46
7	Do	77.9	11.73	25.35	12.57
8	Do	86.1	10.92	22.92	10.96
9	20 kilos N. per hectare	86.5	10.88	21.96	10.92
10	50 kilos N. per hectare	93.2	11.39	24.39	12.46
11	80 kilos N. per hectare	92.0	12.23	24.62	12.65
12	20 kilos N. 30, P_2O_5; 75 K_2O per hectare	94.8	12.68	27.58	14.8
13	30 kilos K_2O	93.5	11.35	24.61	13.18
14	Check	104.4	12.68	30.12	13.80
15	Do	101.1	12.92	25.22	12.86
18	Do	122.3	13.40	30.50	16.54
21	Do	95.5	12.62	32.44	17.32
22	Do	87.6	11.72	20.84	11.72
23	20 kilos N. 30, P_2O_5	95.5	10.30	22.84	11.62
24	50 kilos N. 30, P_2O_5	108.6	11.58	26.42	13.56
25	80 kilos N. 30, P_2O_5	113.5	11.66	27.60	15.3
26	50 kilos N. 30, P_2O_5; 75 K_2O	129.2	11.92	30.20	16.24
27	30 kilos P_2O_5; 75 K_2O	130.5	12.90	32.64	17.64
28	Check	135.5	11.56	32.52	17.50
29	Do	89.5	10.22	19.74	11.94
30	20 kilos N. 75 K_2O	117.7	12.44	27.36	13.96
31	50 kilos N. 75 K_2O	113.1	12.56	25.02	13.12
32	80 kilos N. 75 K_2O	133.2	13.14	31.14	17.28
33	80 kilos N. 30 P_2O_5, 75 K_2O	127.0	13.92	34.44	18.82
34	75 kilos K_2O	141.1	14.24	34.78	17.64
35	Check	138.1	13.60	30.78	16.04
36	Do	99.0	11.36	21.73	10.36
39	Do	132.4	12.94	30.12	15.68
42		135.4	13.56	31.24	16.80

Plot No.	Cured leaf characters				Yield	
	Color	Aroma	Color of ash	Burning quality	Actual	Computed per hectare
				Seconds	*Kilos*	*Kilos*
1	Light	Good	Gray	24	10.172	813.76
4	do	do	do	10	7.483	598.64
7	do	do	Light gray	18	9.032	722.56
8	do	Fair	Gray	23	7.644	611.52
9	do	do	Dark gray	9	7.616	609.28
10	do	Poor	do	12	8.770	701.60
11	do	Fair	Gray	10	9.417	753.36
12	do	Good	Light gray	10	9.763	781.04
13	do	do	do	15	8.739	699.12
14	do	Fair	Dark gray	15	9.851	788.08
15	do	Good	Gray	10	9.948	795.84
18	do	do	Dark gray	20	10.318	825.44
21	do	do	Light gray	20	9.717	777.36
22	do	Fair	Gray	14	8.204	656.32
23	do	Good	do	13	7.210	576.80
24	do	Fair	Dark gray	10	8.916	713.28
25	do	do	do	9	8.978	718.24
26	do	Good	do	14	10.013	801.04
27	do	do	Light gray	30	10.836	866.88
28	do	do	do	15	8.982	718.56
29	do	do	Dark gray	14	7.154	572.32
30	do	do	Gray	9	9.634	770.72
31	do	Fair	Light gray	5	9.671	773.68
32	do	Good	do	10	10.202	816.16
33	do	do	Gray	10	11.174	893.92
34	do	do	do	12	11.465	917.20
35	do	do	Light gray	15	10.652	852.16
36	do	do	Dark gray	16	7.952	636.16
39	do	do	Gray	25	10.055	804.40
42	do	do	Light gray	12	10.535	842.80

TABLE V.—*Fertilizer combinations of the tobacco fertilizer experiment*

[Original plots]

Plot No.	Fertilizers used	Amount of the fertilizers used to $\frac{1}{10}$ hectare	Combinations
		Kilograms	
1	None used	None used	0-0-0
4	Do	do	0-0-0
7	Do	do	0-0-0
8	Do	do	0-0-0
9	Ammonium Sulphate	2.3798	2-0-0
10	Do	5.94955	5-0-0
11	Do	9.520	8-0-0
12	Ammonium sulphate Calcium superphosphate Sulphate of potash	2.3798 3.551 3.949	2-3-7.5
13	Calcium superphosphate	3.551	0-3-0
14	None used	None used	0-0-0
15	Do	do	0-0-0
18	Do	do	0-0-0
21	Do	do	0-0-0
22	Do	do	0-0-0
23	Ammonium sulphate Calcium superphosphate	2.3798 3.551	2-3-0
24	Ammonium sulphate Calcium superphosphate	5.94955 3.551	5-3-0
25	Ammonium sulphate Calcium superphosphate	9.520 3.551	8-3-0
26	Ammonium sulphate Calcium superphosphate Sulphate of potash	5.9495 3.551 3.949	5-3-7.5
27	Calcium superphosphate Sulphate of potash	3.551 3.949	0-3-7.5
28	None used	None used	0-0-0
29	Do	do	0-0-0
30	Ammonium sulphate Sulphate of potash	2.3798 3.949	2-0-7.5
31	Ammonium sulphate Sulphate of potash	5.94955 3.949	5-0-7.5
32	Ammonium sulphate Sulphate of potash	9.520 3.949	8-0-7.5
33	Ammonium sulphate Calcium superphosphate Sulphate of potash	9.520 3.551 3.949	8-3-7.5
34	Sulphate of potash	3.949	0-0-8.5
35	None used	None used	0-0-0
36	Do	do	0-0-0
39	Do	do	0-0-0
42	Do	do	0-0-0

Effect of distances on tobacco (J6-4-21).—Four distance combinations were experimented with, using only the 43-Philippine-Sumatra variety. Planting by the Sumatra method of setting out the plants 50 centimeters apart in alternate rows of 80 and 50 centimeters gave the highest yield—1,690 kilos per hectare—of which quantity 35 per cent by weight was suitable for wrappers. Planting 80 by 50 centimeters gave 1,412.20 kilos per hectare of which 15 per cent was wrapper tobacco, while 80 by 60 centimeters gave 1,350 kilos with 7 per cent wrapper. The plants which were set out 80 by 40 centimeters were so badly worm-eaten and diseased that no records were taken. For more detailed results, see Table VI.

The seeds of the variety used in this experiment were sowed August 28, 1926, germinating on September 10, and the seed-

TABLE VI.—*Effect of distances on tobacco (Experiment J6–4–2)*

Plot No.	Area planted	Station No.	Variety name	Distancing	Stalk characters: Total height	Stalk characters: Middle circumference	Stalk characters: Middle internode length	Green leaf characters: No. standard leaves	Green leaf characters: Dimensions of middle standard: Average length	Green leaf characters: Dimensions of middle standard: Average width	Green leaf characters: Mean breadth index
	Hectares			*Cms.*	*Cms.*	*Cms.*	*Cms.*		*Cms.*	*Cms.*	*Per cent.*
1	.03	43	Philippine Sumatra	80×60	212.10	6.30	7.59	19.50	47.71	25.91	56.0
2	.125	43	Philippine Sumatra	80×50	171.49	6.24	7.51	21.20	46.10	24.90	54.01
3	.25	43	Philippine Sumatra	80×50×50	207.20	6.21	74.8	19.34	45.86	24.72	55.95
4	.03	43	Philippine Sumatra	80×40	(a)	(a)	(a)	(a)	(a)	(a)	(a)

Plot No.	Cured leaf characters: Color	Cured leaf characters: Aroma	Cured leaf characters: Color of ash	Cured leaf characters: Burning quality	Yield: Actual	Yield: Computed per hectare	Yield: Wrappers by weight
				Seconds	*Kilos*	*Kilos*	*Per cent*
1	Brown	Good	Gray	62	40.50	1,350.00	7
2	Light brown	do	do	110	176.50	1,412.20	15
3	Do	Fair	do	121	422.5	1,690.0	35
4							

[a] Badly worm-eaten and diseased; no records taken.

lings were transplanted on November 20, 1926. The soil in the field used was silty loam. The late germination was due to the fact that the beds used were open and only natural rainfall was depended upon for water, as was also true in the fields.

Curing studies (*J7–11–26*).—The only observations made during the year were on the effect of topping aromatic or bright varieties. It was generally found that low topping and late harvesting was conducive to lighter colors and pronounced aroma. The varieties 15-Romero, 76-Kavalha, and 78-South African were used. It was also observed incidentally that at 86 per cent, relative humidity, curing shed diseases begin to appear and affect the curing leaves.

Hybridization (*J9–2–26*).—We had only two F_1 hybrids (Romero x Repollo and Romero x Philippine-Sumatra) during the year. On the whole they behaved as intermediate types between their two respective parents. Two new crosses were effected: Pampano No. 1 x Philippine-Sumatra and Philippine-Florida-Sumatra x Philippine-Sumatra.

The seeds of the hybrids and the parents were sowed in wooden flats on October 10, 1926, germinating 5 to 7 days later, because of regular watering. The soil used was silty loam on the edge of being clay loam and lime was applied at the rate of 1,000 pounds per hectare about a month before transplanting on it.

The following data give an idea of the performance of the F_1 hybrids compared with that of the parents:

Station number and variety name	Generation	Height of plants	Number of standard leaves	Leaf breadth index	Internode length	Stalk circumference
		Cms.	*Units*	*Per cent*	*Cms.*	*Cms.*
43–Philippine Sumatra	P2	144.20	16.84	53.50	5.25	5.10
15–Romero	P1	97.0	12.80	55.00	5.10	4.50
80–Hybrid No. 1	F1	105.00	16.00	56.50	6.60	4.80
10–Repollo	P2	144.50	26.12	41.20	5.20	6.62
15–Romero	P1	97.00	12.80	55.00	5.10	4.50
81–Hybrid No. 2	F1	122.00	19.00	52.50	6.45	5.10

Effect of time of planting (*seasonal*) (*J19–4–24*).—Only the 43-Philippine-Sumatra was used inasmuch as the main problem of the station is wrapper production. The November crop gave the best percentage of wrappers, 15 per cent, although yielding only 1,412 kilos per hectare. The January crop gave 1,488 kilos per hectare of which 8 per cent were wrappers. The March crop was stunted and no records were taken. In the May crop, the leaves were brittle and badly diseased so that no records were taken of it either. For more detailed results see Table VII.

TABLE VII.—*Effect of time of planting on tobacco (Experiment J19-4-24)*

Plot No.	Area planted	Station No.	Variety name	Date planted. (1926)	Stalk characters: Total height	Stalk characters: Middle circumference	Stalk characters: Middle inter-node length	Green leaf characters: No. standard leaves	Green leaf characters: Dimensions of middle standard: Average length	Green leaf characters: Dimensions of middle standard: Average width	Green leaf characters: Mean breadth index
	Hectare				*Cms.*	*Cms.*	*Cms.*		*Cms.*	*Cms.*	*Per cent*
1	.125	43	Philippine-Sumatra	November	171.49	6.24	7.51	21.20	46.10	24.90	54.01
2	.16	43	Philippine-Sumatra	January	144.20	5.10	5.25	16.84	36.45	19.67	53.50
3	.01	43	Philippine-Sumatra	March	(a)	(a)	(a)	(a)	(a)	(a)	(a)
4	.01	43	Philippine-Sumatra	May	(b)	(b)	(b)	(b)	(b)	(b)	(b)

Plot No.	Cured leaf characters: Color	Cured leaf characters: Aroma	Cured leaf characters: Color of ash	Cured leaf characters: Burning quality	Yield: Actual	Yield: Computed per hectare	Yield: Wrappers by weight
				Seconds	*Kilos*	*Kilos*	*Per cent*
1	Light brown	Good	Gray	110	176.50	1,412.20	15
2	Do	do	do	15	23.79	1,488.00	8
3	(c)	(c)	(c)	(c)	(c)	(c)	(c)
4	(c)	(c)	(c)	(c)	(c)	(c)	(c)

[a] Stunted; no records taken.
[b] Leaves too brittle and badly diseased.
[c] No records taken.

The seeds used were sowed August 28, September 30, and December 29, 1926, and February 28, 1927, respectively, for the four plantings. The seedlings were set out November 20, 1926, January 15, March 15, and May 16, 1927, respectively. In the two earlier plantings, the soil used was a silty loam while in the latter two, a clay loam. In all cases the plants were set out 80 by 50 centimeters apart.

Water requirement experiment (J22–1–26).—One hundred per cent, 80 per cent, 60 per cent, 50 per cent, 20 per cent, and 5 per cent saturations with garden and alluvial soils were tried. Unfortunately, when the plants were about 12 to 35 centimeters in height, they were badly attacked by the tobacco stem borer so that the experiment had to be suspended. However, as the records taken indicated that 60 per cent saturation gave the best results. The variety 12-Pampano No. 1 was used. For more detailed results, see Tables X and XI.

This was a pot experiment utilizing petroleum cans. Two kinds of soils were used—alluvial and common garden (clay loam). The soils were first dried by ordinary air draft and samples were latter dried in the laboratory oven for 24 hours, after which they were reweighed to determine the amount of moisture still present after being air-dried, to facilitate the measurement of the exact amount of water to be added to each pot to make the different saturations. It was of course also necessary to determine as a basis the exact amount of water necessary to make the soil 100 per cent saturated by actually saturating a weighed oven-dried sample. Tables VIII and IX give for each culture the actual weight of the soil, the per cent of moisture in the air-dried soil, the amount of water added to the soil for the different saturations, and the total combined weight of the soil and water.

Pot fertilizer experiment (J24–1–26).—The triangular system was adopted in $8\frac{1}{3}$ per cent stages. There should be 91 possible combinations therefor but actually there were used only 16 triple combinations regularly scattered in the triangular system. (See Plate II.) Ammonium sulphate was the source of the nitrogen; acid phosphate of the phosphoric anhydride and sulphate of potash of the potassium. The variety used was 12-Pampano No. 1. Plots 220 and 230 with an application of 100 kilos of nitrogen, 40 kilos of potash, and 100 kilos of phosphoric anhydride produced the biggest leaves.

Table XII gives for each culture the rate of fertilizer application; the individual and average height of plants, the

average size of 5 standard leaves, the individual and average dry weight of standard (except the lower ones) and top leaves; the individual and average dry weight of stem, the color, aroma, color of ash and burning quality of the cured leaves.

TABLE VIII.—*The degree of saturation of soil (alluvial soil)*

Number of culture	Weight of cans	Weight of soil	Moisture content of soil	Amount of H_2O added to the soil	Total amount of H_2O and soil	Saturation
	Kgs.	*Kgs.*	*Per cent*	*Kgs.*	*Kgs.*	*Per cent*
1	1.2	17	18	10.37	27.37	100
2	1.0	17	18	10.37	27.37	100
3	1.2	17	18	10.37	27.37	100
4	1.15	17	18	5.26	22.26	80
5	1.22	17	18	5.26	22.26	80
6	1.1	17	18	5.26	22.26	80
7	1.2	17	18	3.94	20.94	60
8	1.0	17	18	3.94	20.94	60
9	1.0	17	18	3.94	20.94	60
10	1.2	17	18	3.28	20.28	50
11	1.15	17	18	3.28	20.28	50
12	1.0	17	18	3.28	20.28	50
13	1.0	17	18	1.97	18.97	30
14	1.11	17	18	1.97	18.97	30
15	1.2	17	18	1.97	18.97	30
16	1.15	17	18	1.31	18.31	20
17	1.1	17	18	1.31	18.31	20
18	1.2	17	18	1.31	18.31	20
19	1.0	17	18	.66	17.66	10
20	1.0	17	18	.66	17.66	10
21	1.2	17	18	.66	17.66	10
22	1.2	17	18	.33	17.33	5
23	1.2	17	18	.33	17.33	5
24	1.0	17	18	.33	17.33	5

TABLE IX.—*The degree of saturation of soil (common garden soil)*

Culture number	Weight of pots	Weight of soil	Moisture content of soil	Amount of H_2O added to the soil	Total amount of water and soil	Saturation
	Kgs.	*Kgs.*	*Per cent*	*Kgs.*	*Kgs.*	*Per cent*
1	1.10	17	20	9.18	26.18	100
2	1.0	17	20	9.18	26.18	100
3	1.21	17	20	9.18	26.18	100
4	1.2	17	20	3.94	20.94	80
5	1.10	17	20	3.94	20.94	80
6	1.10	17	20	3.94	20.94	80
7	1.22	17	20	2.81	19.81	60
8	1.05	17	20	2.81	19.81	60
9	1.0	17	20	2.81	19.81	60
10	1.0	17	20	2.34	19.34	50
11	1.20	17	20	2.34	19.34	50
12	1.20	17	20	2.34	19.34	50
13	1.20	17	20	1.40	18.40	30
14	1.1	17	20	1.40	18.40	30
15	1.1	17	20	1.40	18.40	30
16	1.15	17	20	.94	17.94	20
17	1.1	17	20	.94	17.94	20
18	1.2	17	20	.94	17.94	20
19	1.05	17	20	.47	17.47	10
20	1.1	17	20	.47	17.47	10
21	1.1	17	20	.47	17.47	10
22	1.15	17	20	.23	17.23	5
23	1.2	17	20	.23	17.23	5
24	1.0	17	20	.23	17.23	5

TABLE X.—*Weekly measurement of each plant in each pot alluvial soil (triplicated)*

Date of measurement

Culture number		April 6	April 13	April 20	Average	Average of the averages
		Cms.	*Cms.*	*Cms.*	*Cms.*	*Cms.*
5 per cent	1	12	12	12.5	12.16	12.6
	2	Dead	Dead	Dead	....	
	3	...do...	...do...	...do...	....	
10 per cent	4	19	21	22	20.66	24.24
	5	25.5	29	29	27.83	
	6	Dead	Dead	Dead	....	
20 per cent	7	16	18	20	18.00	18.00
	8	Dead	Dead	Dead	....	
	9	...do...	...do...	...do...	....	
30 per cent	10	16	18	19	17.66	20.33
	11	31	34	37	34.00	
	12	6	10	12	9.33	
50 per cent	13	18	19	27	21.33	25.05
	14	23	25	35	27.66	
	15	24	27	27.5	26.16	
60 per cent	16	23	24	36	27.66	27.33
	17	26	27	28	27.00	
	18	Dead	Dead	Dead	....	
80 per cent	19	20	22	25	21.66	21.44
	20	16	20	21	19.00	
	21	21	24	26	23.66	
100 per cent	22	Dead	Dead	Dead	....	(....)
	23	...do...	...do...	...do...	....	
	24	...do...	...do...	...do...	....	

TABLE XI.—*Weekly measurement of each plant in each pot common garden soil (triplicated)*

Culture number		April 6	April 13	April 20	Average	Average of the averages
		Cms.	*Cms.*	*Cms.*	*Cms.*	*Cms.*
5 per cent	1	4	6	6.1	5.36	5.36
	2	Dead	Dead	Dead	....	
	3	...do...	...do...	...do...	....	
10 per cent	4	10	13	16	13	14.16
	5	10	12	24	15.33	
	6	Dead	Dead	Dead	....	
20 per cent	7	14	16	17	15.66	15.22
	8	15	17	19	17.00	
	9	12	13	14	13.00	
30 per cent	10	15	18	20	17.66	16.83
	11	15	16	17	16.00	
	12	Dead	Dead	Dead	....	
50 per cent	13	10	12	12	11.33	23.33
	14	30	31	32	31.00	
	15	26	27	30	27.66	
60 per cent	16	20	31	40	30.33	25.99
	17	19	23	29	23.66	
	18	18	24	30	24.00	
80 per cent	19	16	21	23	20.00	22.22
	20	23	29	31	27.66	
	21	18	19	20	19.00	
100 per cent	22	Dead	Dead	Dead	....	(....)
	23	...do...	...do...	...do...	....	
	24	...do...	...do...	...do...	....	

TABLE XII.—*Fertilizer requirement of tobacco (Experiment J24–1–26)*

Plot No.	Fertilizer application per hectare			
	Nitrogen (N)	Potash (K_2O)	Phosphoric acid (P_2O_5)	Total
	Kilograms	*Kilograms*	*Kilograms*	
100	Control—None..	None.....	None.....	0
110	Do........	.....do...	.....do...	0
120	20	20	200	240
130	20	20	200	240
140	80	20	140	240
150	80	20	140	240
160	140	20	80	240
170	140	20	80	240
180	200	20	20	240
190	200	20	20	240
200	40	40	160	240
210	40	40	160	240
220	100	40	100	240
230	100	40	100	240
240	160	40	40	240
250	160	40	40	240
260	20	80	140	240
270	20	40	140	240
280	80	80	80	240
290	80	80	80	240
300	140	80	20	240
310	140	80	20	240
320	40	100	100	240
330	40	100	100	240
340	100	100	40	240
350	100	100	40	240
360	20	140	80	240
370	20	140	80	240
380	80	140	20	240
390	80	140	20	240
400	40	160	40	240
410	40	160	40	240
420	20	200	20	240
430	20	200	20	240

Plot No.	Total plant height	Average plant height	Average size of 5 standard leaves	Dry weight of leaves	Average dry weight of leaves	Dry weight of stems	Average dry weight of stems
	Cms.	*Cms.*	*Sq. cms.*	*Grams*	*Grams*	*Grams*	*Grams*
100	46.5	65.75	247.9	8	13.5	24	39
110	85.0			19		54	
120	227.5	168.75	319.8	15	15	57	62
130	110.0			15		67	
140	63.75	68.62	388.5	11	13	25	39.5
150	73.5			15		46	
160	93.25	86.12	438.85	15	14.5	48	54
170	79.00			14		60	
180	97.00	82.50	408.25	17	18	48	47.5
190	68.00			19		47	
200	120.00	104.12	404.6	20	17.5	66	53.5
210	88.25			15		41	
220	132.5	110.02	429.65	17	15.5	79	66.5
230	88.0			14		54	
240	67.0	79.5	403.2	10	11.5	42	44.5
250	92.0			13		47	
260	78.0	74	339.2	4	7	50	47.5
270	70.0			10		45	
280	75.0	86.25	382.05	10	12.5	47	54
290	97.5			15		61	
300	73.25	68.87	354.55	13	10.5	50	49
310	64.5			8		48	
320	50.0	44.0	270	12	9.5	34	27
330	38.0			7		20	
340	112.0	94.75	329.35	31	23	63	56.5
350	77.5			15		50	
360	59.0	58.25	281.2	10	9	28	29.5
370	57.5			8		31	
380	67.0	69.25	286.45	10	10	45	45.5
390	76.5			10		46	
400	62.0	70.0	363.8	11	12	38	43.0
410	78.0			13		48	
420	47.5	57.5	241.0	5	10.25	16	31
430	67.5			15.5		46	

TABLE XII.—*Fertilizer requirement of tobacco* (*Experiment J24-1-26*)—Continued

Plot No.	Color	Aroma	Color of ash	Burning quality (duration glow in seconds)
100	Brown	Good	Black	120
110	Light brown	do	do	63
120	Dark	do	do	94
130	Light brown	do	do	107
140	Do	do	do	35
150	Do	do	do	21
160	Do	do	do	18
170	Do	do	do	33
180	Do	do	do	36
190	Do	do	Dark gray	50
200	Brown	do	Black	54
210	Dark brown	do	do	69
220	Brown	do	Dark gray	38
230	Light brown	do	Black	37
240	Do	do	Dark gray	65
250	Brown	do	do	76
260	Light brown	do	Black	44
270	Do	do	Dark gray	44
280	Do	do	Black	91
290	Do	do	do	99
300	Do	do	do	32
310	Do	do	do	62
320	Do	do	Dark gray	52
330	Do	do	Black	25
340	Do	do	do	82
350	Brown	do	Dark gray	63
360	Light brown	do	Black	39
370	Do	do	do	60
380	Do	do	do	13
390	Do	do	do	51
400	Do	do	do	30
410	Dark brown	do	do	81
420	Brown	do	do	35
430	Light brown	do	Dark gray	67

Bright or cigarette variety tests (*J26-1-26*).—Four varieties were used. 78-South African gave the highest yield with 1,047 kilos per hectare, followed by 29-Olsen No. 1 with 706 kilos, 15-Romero with 568.31 kilos, and 76-Kavalha with 464 kilos. In aroma, however, 76-Kavalha was the best.

The seeds of all the varieties used in this experiment were sowed on October 10, 1926, in wooden flats, germinating 5 to 7 days later, and the seedlings were transplanted at the same time, December 23, 1926. The soil of the field used is technically silty loam also but wih a tendency to be clay loam. The bigger varieties, 29-Olsen No. 1 and 15-Romero, were set out in the field 70 centimeters apart in rows 80 centimeters apart while the smaller varieties, 76-Kavalha and 78-South African, were set out 50 centimeters apart in rows 80 centimeters apart also. Lime was applied to the field at the rate of 1,000 pounds per hectare a month before planting.

For more detailed data, see Table XIII.

TABLE XIII.—*Aromatic or cigarette variety test (experiment J26-1-26)*

Plot Number	Area planted	P. I. Number	Station Number	Variety name	Stalk characters: Total height	Stalk characters: Middle circumference	Stalk characters: Middle internode length	Green leaf characters: Number standard leaves	Green leaf characters: Dimensions of middle standard: Average length	Green leaf characters: Dimensions of middle standard: Average width	Green leaf characters: Mean breadth index
	Hectare				*Cms.*	*Cms.*	*Cms.*		*Cms.*	*Cms.*	*Per cent*
1	.01	9112	78	South African	82.25	3.97	3.77	30.80	23.70	12.06	49.87
2	.01	8726	29	Orinoco (Olsen No. 1)	96.00	6.48	2.52	22.56	41.28	15.22	35.70
3	.035	8741	15	Romero	97.00	4.50	5.10	12.80	37.20	18.96	55.00
4	.01	9085	76	Kavalha	106.20	4.12	3.48	23.20	23.32	12.84	54.50

Plot Number	Cured leaf characters: Color	Cured leaf characters: Aroma	Cured leaf characters: Color of ash	Cured leaf characters: Burning quality	Yield: Actual	Yield: Computed per hectare
				Seconds	*Kilos*	*Kilos*
1	Brown	Good	Gray	11	10.47	1,047.00
2	Dark brown	do	do	40	7.06	706.00
3	Do	Fair	do	31	19.90	568.31
4	Brown	do	do	10	4.64	464.00

THE EFFECT OF STRIPPING OFF THE DEAD LEAVES OF SUGAR CANE ON THE YIELD OF SUGAR

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In some countries the stripping off of the dead leaves adhering to the cane stalks is widely practised. But in Southern India, instead of stripping off these dead leaves the stalks are wrapped in half-dead leaves with the object of preserving the buds from shooting and the internodes from cracking and also to prevent the jackals from eating the cane.

Deerr(1) stated that the reasons given for stripping are:

1. The removal of the leaves exposes the cane to the effect of light and air, and thereby hastens its maturity.
2. The dead leaves afford harbouring places for obnoxious insects, especially plant lice and mealy bugs.
3. Water lodging in the leaf axils promotes the development of the eyes and aerial roots, to the detriment of the cane.
4. The dry leaves being placed on the ground act as a mulch and help to conserve soil water.

Boname(2), who strongly favors the process of stripping, found the following:

Items	Only completely dried leaves removed	Cane stripped certain number of green leaves removed	No stripping
Degree Baume	8.10	7.50	7.70
Sugar per cent	13.40	11.60	12.20
Glucose per cent	1.30	1.56	1.20

Eckart(3) found in the Hawaiian Islands under a variety of conditions that unstripped cane gave both a higher yield and a sweeter and purer juice. Rosenfeld(4) stated that under Porto Rican conditions stripping seems not to be profitable.

In the Philippines, so far as known, no experiment regarding this point was ever made before.

OBJECT OF THE PRESENT WORK

The experiment herein described was begun August, 1924, and closed in December, 1927. It consisted of two tests corre-

sponding for two successive crop years. Test I was made during the crop year of 1925–26 and Test II during the crop year of 1926–27. The work was conducted in the experimental fields of La Carlota Sugar-Cane Experiment Station of the Bureau of Agriculture at La Carlota, Occidental Negros.

It had three main objects, which were: (1) to find out whether stripping off the dead adhering leaves has any good effect on the sucrose, purity, and yield of the cane; (2) to find out the right time to do the stripping work so that it would be beneficial for the yield of the cane; and (3) to determine whether it is economical to do stripping work under Philippine conditions.

MATERIALS AND METHOD

A rectangular field of 4,500 square meters was used for Test I and another rectangular field of 21,600 square meters for Test II. Both fields had good drainage and in both the soil was a clay loam. The area used for Test I was quite small due to the limited area of available land when the test was conducted. The two fields were divided into nine equal plots each and numbered. The plots in Test I contained 500 square meters each while in Test II they had 2,400 square meters each.

The sugar-cane variety used for the two tests was Negros Purple and the spacing was 120 centimeters between the furrows and 40 centimeters between the hills in the furrows.

There were two stages of stripping considered in this work, early and late. By early stripping is meant the removing of the dried leaves adhering to the cane stalks with a certain number of the matured leaves when the cane plants are about in their full growing stage, usually in the month of June, and by late stripping their removal about the time when the growth of the cane plant is about to stop, i. e., usually some time in October.

EXPERIMENT AND RESULT

Test I.—This test was started August 19, 1924. The field was plowed twice with a disc plow pulled by four work bullocks and once with single mould board plows. It was harrowed with a bamboo harrow after each plowing. On November 18, 1924, the plots were all planted. Similar cultivation was given to all of the plots from time to time consisting of six plowings of the spaces between the rows and two weedings in the cane rows.

On June 14, 1925, when the canes were seven months old early stripping was done in plots 2, 4, 6, and 8, respectively. On October 14, 1925, or four months afterwards, plots 2, 3, 6,

and 7 received the late stripping, so that plots 2 and 6 were given both the early and late stripping. Plots 1, 5, and 9 were unstripped as control.

The canes of every plot were harvested and milled separately at La Carlota Sugar Central on February 19, 1926. The following table shows the results obtained:

TABLE I.—*Showing the actual and theoretical yield*

Plot number and treatment	Brix C. J.	Suc. C. J.	Purity C. J.	Piculs sugar per T. cane	Actual T. cane per hectare	Theoretical T. cane per hectare	Piculs of sugar per hectare
		Per cent					
1. Control	18.1	16.6	91.6	1.97	40.10	44.90	88.42
2. Early and late	18.0	15.8	87.6	1.86	58.08	60.25	112.06
3. Late	18.9	15.7	83.2	1.78	62.44	62.44	111.14
4. Early	18.3	15.3	83.6	1.74	39.92	37.75	65.69
5. Control	17.6	14.6	83.3	1.66	48.80	44.90	74.53
6. Early and late	18.6	16.3	87.9	1.91	48.40	46.68	89.15
7. Late	19.1	17.3	90.6	2.04	50.68	50.68	103.38
8. Early	18.6	16.3	88.0	1.91	58.66	60.38	115.32
9. Control	18.1	16.1	89.3	1.90	41.90	44.90	85.31

Test II.—The preparation of the field for this test was started on August 4, 1925. The field was first plowed with a disc plow and then replowed five times with single mould board plows from time to time and harrowed after each plowing. On November 20, 1925, all the plots were planted. As soon as cultivation was found necessary it was given in the same way to all plots. In all there were five plowings between the rows and two weedings in the cane rows before the field was closed.

The early stripping for this test was done June 20, 1926 in plots 2, 4, 6, and 8. On October 20, 1926, plots 2, 3, 6, and 7 were given the late stripping. Plots 2 and 6 in this case received two strippings also. Plots 1, 5, and 9 were left unstripped as control.

The canes of every plot were harvested and milled separately at La Carlota Sugar Central on December 7, 1927. The following were the results obtained:

TABLE II.—*Showing actual and theoretical yield*

Plot number and treatment	Brix C. J.	Sucrose C. J.	Purity C. J	Piculs sugar per T. cane	Actual T. cane per hectare	Theoretical T. cane per hectare	Piculs of sugar per hectare
		Per cent					
1. Control	18.8	16.0	85.1	1.88	72.15	74.08	139.27
2. Early and late	17.2	15.1	87.8	1.79	70.46	71.32	127.66
3. Late	16.8	14.0	83.3	1.63	71.64	71.87	117.15
4. Early	16.5	14.0	84.8	1.64	74.39	74.20	121.69
5. Control	16.3	13.5	82.2	1.58	73.19	74.08	117.05
6. Early and late	15.0	12.3	82.0	1.44	90.30	91.29	131.45
7. Late	17.0	15.0	88.2	1.81	78.05	78.05	141.27
8. Early	15.7	13.2	84.6	1.56	69.80	68.81	107.34
9. Control	16.3	13.6	82.9	1.57	77.17	74.08	116.31

By examining carefully the actual cane yield per hectare of the plots of Test I and Test II from tables I and II, respectively, it can be assumed that the soil fertility of the fields was not uniform. In Test I the fertility increased from both ends toward the middle or from plots 1 and 9 toward plot 5. In Test II the fertility increased from plot 1 toward plot 9.

TABLE III.—*Showing average analysis and yield per hectare*

Treatment	Brix C. J.	Sucrose C. J.	Purity C. J.	Piculs of sugar per T. of cane	Theoretical tons cane per hectare	Piculs of sugar per hectare
		Per cent				
Control	17.5	15.0	85.7	1.76	59.49	103.48
Early and late	17.2	14.9	86.3	1.75	66.93	115.08
Late	17.9	15.5	86.3	1.82	65.76	118.23
Early	17.3	14.9	85.2	1.71	60.28	102.50

This table shows the average analysis of the juice and yield per hectare for the two crop years. This table shows that late stripping gave the highest per cent sucrose, consequently the most piculs of sugar per ton of cane too. This result corroborates the finding of Boname (2) that removing only the completely dried leaves from the canes gave the highest sugar per cent. The early stripping and the two strippings both gave 0.1 per cent sucrose lower than the control, and 0.6 per cent lower than the late stripping. This shows that early stripping has quite a strong detrimental effect on the sucrose content of the cane that can not be overcome by the good effect of late stripping.

The canes that received two strippings gave the most tons of cane per hectare, the late stripping the next highest number, the early stripping the next, and the control the least. But due to the high sucrose content of the late stripping the sugar yield per hectare of this gave the highest of all—118.23 piculs. The plot that received two treatments gave 115.08 piculs only or 3.25 piculs less than the late stripping. The early and the control gave practically the same sugar yield per hectare, 102.50 and 103.48 piculs, respectively. The fact that late stripping alone, and early together with late stripping, both gave more tons of cane and sugar per hectare is an evidence that late stripping has a good effect on the yield of Negros Purple.

EXPENSES AND GAIN PER HECTARE

The cost of the preparation of the ground per hectare from the first plowing, furrowing, and planting up to the last cultivation

including the depreciation of the implements used and cost of animal labor was ₱160.56 for Test I and ₱145 for Test II. The average cost of the preparation of the ground, therefore, for the two tests amounted to ₱152.75. The cost of stripping for Test I was ₱6.60 per hectare and for Test II it was only ₱5.06 per hectare. The average cost of stripping per hectare, then, was ₱5.83.

The harvesting was done by contract at the rate of ₱2.20 per ton of cane, that is, 50 centavos for cutting the canes, ₱1.40 for hauling same from the field to the railroad station, the animal and cart being owned by the hauler, and 30 centavos for loading the cane into cars.

TABLE IV.—*Showing the net gain per hectare*

Items	Control	Early and late	Late	Early
Value of 55 per cent of sugar produced as share of planter at ₱10 per picul	₱569.14	₱632.94	₱650.27	₱563.75
Preparation of ground up to last cultivation	152.78	152.78	152.78	152.78
Cost of stripping	....	11.66	5.83	5.83
Cost of harvesting	130.88	147.25	144.67	132.62
Total expenses	283.66	311.69	303.28	290.23
Net gain per hectare	285.48	321.25	346.99	273.52

Table IV shows the net gain per hectare based on the average yield and average expenses per hectare from the two tests. From this table it can be seen that late stripping gave the highest net gain per hectare, or ₱73.47 more than the early stripping, ₱61.51 more than the control, and ₱25.74 more than the two strippings; and that early stripping gave ₱11.96 les net gain than the control. Under actual conditions in the Philippines late stripping could be practised on a commercial scale at a profit even if the expenses for stripping were increased 100 per cent over the actual expense of stripping incurred in this investigation. On the contrary, early stripping should not be practised as it only makes extra labor and expense without any appreciable increase in production.

SUMMARY OF CONCLUSIONS

From the results obtained from this present work, the following conclusions may be drawn:

1. Stripping off the adhering leaves on the cane stalks generally increased the sucrose content and purity of the cane and also increased the cane and sugar yield per hectare.

2. Late stripping or stripping off the dead adhering leaves about the time when the growth of the cane plant was about to stop, which was along in October, gave the highest per cent of sucrose, purity and sugar yield per hectare. It also gave the biggest net profit, ₱61.51 more than the net profit of the control.

3. Early stripping or the removal of the dead adhering leaves together with a certain number of matured ones on the cane stalks when the cane plants were about in their full growing stage, some time in June resulted in ₱11.96 less net profit than the control.

REFERENCES

4. The combined use of early and late stripping increased the cane and sugar yield per hectare, but if compared with the late stripping alone it showed no compensation or profit.

5. Under actual Philippine conditions late stripping is to be recommended for commercial purposes as profitable even if the expenses for stripping show an increase of 100 per cent over the other expenses.

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2. Culture de la Canne a Sucre a Guadaloupe.
3. H. S. P. A. Ex. Sta., Agric. Ser., Bull 25
4. The Journal of the Department of Agriculture of Porto Rico, 1927, Vol. XI, Nos. 1–4.
5. A Manual of Plant Breeding for the Tropics, by N. B. MENDIOLA.

A GUIDE FOR MAKING PANOCHA

By Anselmo Labrador

Acting Superintendent, La Carlota Sugar Cane Experiment Station

Panocha is the commercial term given to a kind of sugar produced in some sections of the Philippine Islands where sugar cane is raised. This kind of sugar is consumed locally. The sugar after cooking is solidified in coconut shells usually and allowed to cool. The lumps of sugar thus formed after being taken from these shells are termed "panocha."

Generally the mill and utensils employed for making panocha are crude. In many cases, where transportation is difficult, a wooden mill is common.

The governing principle in making panocha is almost the same as in muscovado making. The canes selected for the purpose should be medium and erect. These give a juice of higher purity than the lodging canes, which is consequently easier to boil into sugar. Lodging or falling cane is usually watery and has many impurities on account of the hairy roots that develop when the stalks touch the ground. These roots carry with them fine particles of earth which bring down the purity of the juice. The cane should be topped well and cut clean with no trash adhering to prevent the juice from getting impurities. The cane should be hauled immediately after cutting to the mill in order to prevent the souring of the juice. Cut cane begins fermenting after 24 hours.

One or two weeks before milling, the mill and other utensils used in the manufacture of sugar should be thoroughly cleaned. This should be done every week during the milling season. The mud and other impurities obtained during the clarification of the juice, if not properly disposed of, will become sour, thus favoring the developing of microörganisms that cause the souring of the juice and the lowering of the polarization of sugar.

LIMING

Only first-class lime should be employed in this work. One kilo of lime is dissolved in 6 kilos of water. After stirring it thoroughly a thick white solution is formed known as milk of

lime. This lime solution is added to the juice little by little until the juice is completely neutralized. The "maestro" in charge must exercise good judgment in the application of the proper amount of lime. If too little of it is used, there will be incomplete precipitation of the impurities in the juice and poor clarification, while if too much is used and alkalinity is reached, there will be a darkening of the juice when heated at a high temperature caused by the decomposition of the reducing sugars by the lime and the resulting sugar will be of poor quality. The quantity of lime to be used will depend to some extent upon the quality of the juice. If the juice is of high purity liming should be at neutrality. If the juice is of poor quality, overliming is sometimes resorted to.

The two most common indicators used are litmus paper and phenolphthalein. The juice is treated with prepared lime solution little by little until the point of neutrality is reached by means of indicators. Litmus paper should be kept within reach by the farmers. An experienced "maestro" can determine this point of neutrality without the aid of the indicator by:

1. The color of the juice after liming.
2. The smell of the juice so treated.
3. The rate of settling of the precipitated impurities.

CLARIFICATION

The clarification of the cane juice is of supreme importance for the quality of the sugar depends largely upon the clarity of the juice. In order to obtain good clarification it is indispensable that the juice be heated as soon as possible after being extracted from the mill, so as to prevent all action of microörganisms and that the reaction of the juice when at a high temperature should be either neutral or only slightly acid or alkaline depending upon the quality of the juice.

Another important factor in making panocha is the complete removal of the floating impurities, both those arising from the hard particles of the cane passing into the juice, and those precipitated from the juice by the clarification process. The juice after liming is heated to the "cracking point." The impurities formed by the precipitate of lime accumulate at the surface and are skimmed off until the solution is partly cleared. These impurities are placed in barrel to settle and the partly clean solution is transferred into the settling tanks for at least 24 hours. The clear juice resulting thereof is then drawn off into the open kettles for concentration.

CONCENTRATION OF THE JUICE

The concentration of the clarified juice containing about 15 per cent sugar is effected in two ways; viz., *evaporation,* which concentrates the juice into syrup containing about 50 per cent sugar, and *boiling* which concentrates this syrup still further to massecuites containing about 90 per cent sugar. This operation is performed in a series of iron vats or kettles 5 to 6 in number. The last vat is usually used for liming the juice, the 2nd, 3rd and 4th, for evaporation and clarification and the first one is for the final concentration.

The clarified juice is evaporated in the middle of the series of vats to syrup consistency and at the same time further clarification is effected by skimming off the scum.

When the juice has reached the syrup consistency the fire is turned low to prevent burning and overflowing. (Coconut milk is often employed to prevent frothing.)

The whole mass is frequently stirred and the concentration of the syrup is continued up to the point where there is not sufficient water for the sugar to remain dissolved. As the boiling is done in an open kettle, minute crystals which are hardly visible to the naked eye are formed at this stage of concentration. This point or stage of concentration is known in sugar making as the "strike." The point of strike is hard to determine and only an experienced "maestro" should handle this job. The method followed is to dip a proof stick into the sticky mass (massecuites) and then allow it to drip. If the mass forms needle-like threads or if it gets hard and brittle when immersed in cool water, then it is already cooked. An experienced "maestro" is also guided by the smell and color of the mass while boiling.

The mass when already cooked is constantly stirred with a wooden paddle to hasten crystallization. The rapidity with which sugar crystallizes from a solution depends on the purity of the solution. When a sugar solution is fairly pure, crystallization takes place very slowly, and no crystals are visible even after it has been stirred for quite a long time.

When the crystals are beginning to form, the mass is placed in moulds that are usually made of coconut shells and then is allowed to get hard upon cooling. The resulting sugar when taken from the moulds is "panocha."

CONTROL MEASURES FOR THE ANTHRACNOSE DISEASE OF THE MANGO[1]

By F. M. CLARA
Assistant Pathologist

1. Only healthy seedlings should be planted and as soon as even the least sign of the disease is noticed, removal of the infected parts is advisable. Follow this with a Bordeaux mixture spray or with any of the standard fungicides in weekly or twice a month treatments until the disease is controlled. The number and frequency of applications will depend upon the individual cases and existing weather conditions. On rainy days more treatments are usually necessary. Control work should be started with the young plants, as big trees would be more diffiult to work on. Insect pests, particularly leaf miners and others which serve to spread the disease and injure the plants in any manner, should also be suppressed.

2. Fruits showing the symptoms of the disease should be put together in separate baskets, "cajengs" or crate. They should not be included with sound fruits as they will serve as sources of infection for the others. Sorting the fruits and discarding those that are infected will greatly help to reduce the damage. Store the fruits in dry and well ventilated rooms and prevent injuries as much as possible. In packing for shipment, care should be taken not to use stiff materials, such as hard leaves and straw as layers, because these will cause bruises on the fruits. Such injuries offer a good ground for the disease germs to grow in. Strongly made baskets or boxes should be used, instead of the flexible "cajengs."

Disinfection tests with borax solution, 2.5 per cent to 8.5 per cent, made in the laboratory, seem to decrease the amount of damages due to fruit rot. Borax is a chief and easily available material which makes it preferable to other chemicals and does not prevent ripening. Treatment should be given just after gathering the matured fruits, while the spores of the fungi have not as yet started to grow. They should then be dipped in the solutions of borax (sodium borate) 5 to 10 minutes and dried before finally packing for shipping.

3. Other plants which are known to be attacked by the disease should not be planted with or alongside of mangoes.

4. The use of resistant varieties would be the most practical control measure if such varieties could be found.

[1] For description, symptoms, etc., see Agricultural Review, Vol. XX, No. 2, p. 271.

NOTES—FOURTH QUARTER

BEAT THIS IF YOU CAN

By CORNELIO V. CRUCILLO
Agricultural Extension Agent

In a conspicuous open space in the barrio of Dampol 1st, Pulilan, Bulacan, about five minutes' hike from the provincial road, stands a giant mango tree which is in many ways the champion of its class in the Philippines and possibly in the world. (See Plates I and II).

This huge mass of living green, according to some information, started life about 100 years ago when, from its lethargy as a seed, it awakened one happy day at Dame Nature's own command, to enjoy the blessings of our tropical clime. For almost a century, imagine, it has stood its ground against everything that our changeable weather conditions could offer—typhoons, floods, droughts, warmth, and cold, and what not, and gradually has grown to its present dimensions and fruitfulness.

The expanse of its crown measures 48 meters lengthwise and 36 meters crosswise, both measurements passing through the center of the tree and perpendicular to each other; that is to say, the crown is almost elliptical in formation. From these figures, the circumference of the crown may be computed to be 132 meters and the area of the ground covered by the crown, 1,357 square meters. The tree, in spite of its monstrous size, is only of an ordinary height, for its branches instead of shooting directly skyward, grow horizontally, in many cases crawling on the ground, as may be seen in the picture. This condition may be explained by the fact that when the tree was in the prime of youth, erect and proud in its early twenties as any of its clan, it was uprooted and felled to the ground by a terrific storm. The owner then thought that it was going to die, but wait! the tree held on and from its prostrate position continued to fight for dear life. Little by little its main trunk was covered with soil and began to grow roots and send off branches. New roots and new branches they were. And these branches, strange as it may seem, did not choose the upward trend of growth; they crept on the ground instead or grow parrallel to it thus establishing a foundation that is in every sense storm-

Exterior view of the biggest mango tree in Bulacan showing the expanse of the crown which measures 48 meters lengthwise and 36 meters crosswise.

A section of the tree showing the manner of growth and distribution of branches. Note how some of the branches crawl on the ground.

proof. The tree has "come back" indeed! Now, storm after storm may come and may succeed in wresting from the tree some of its minor branches, but it will never again be laid low; it will never again experience the same humiliating shock that it received from that merciless storm of about eight decades ago, but will remain erect where it is to its last day with its branchlets gracefully swaying and its million leaves gently murmuring with the breeze.

And most important of all, it will continue serving its owner in the same fashion as of old. It is a very productive tree; its annual production is between 10,000 and 15,000 fruits which net the owner an average amount of from ₱500 to ₱1,000. Just imagine the amount of money this lone tree has already produced. From the American occupation of these Islands to the present day alone it must have produced no less than ₱20,000 worth of fruit. And then there was that long stretch of time from its first year of bearing to the end of the Spanish régime. I should say a fortune has already been realized from this remarkable tree. During the Spanish time the highest income it yielded for one year was recorded to be around ₱500. In the year 1925, it reached the zenith of its production by yielding 35,000 fruits sold wholesale as usual while still on the tree for the almost unbelievable sum of ₱1,500. It was while performing this record-breaking feat that the crown of the tree changed from the circular form to the elliptical. One of its main branches was so heavily loaded with fruit that in spite of all precautions made to protect it from breaking, it gave way before the fruit could be picked, crushing another branch beneath it.

The tree is so dear to the owner that it is being accorded every care and protection possible. It is surrounded by a double row of fences, the first or inner row being constructed of bared wire, and the outer row of bamboo ends and simply growths replenished every year. The owner, Mr. Emilio Dionisio, when asked if he would ever sell the tree, replied: "That mango tree is the last thing in the world I would part with."

If this tree is not a world-beater, well then, show me one.

FROM OUR CONTEMPORARIES

THE CASHEW NUT

By F. N. Howes

In certain parts of South America wine is made from the cashew fruit. And because of its resistance to insect attack, the

gum exuding from the bark of the tree is made use of in bookbinding in said country, and in India. Cardol or cashew apple oil, which is resistant to termite attack and therefore a good preservative for books and woodwork, and is used for tarring boats in India, is obtained from the shells after removal of the kernels. From the latter an oil that is similar to almond and olive oil is extracted. The tree yields a sap which has been found to be good indelible marking ink for linen. (The Journal of the Gold Coast Agricultural and Commercial Society. Vol. 6, No. 2, April-June, 1927.)

REPORT ON THE ECONOMIC IMPORTANCE OF THE DAMAGE DUE TO TERMITES OR WHITE ANTS IN ACCRA AND ACHMINOTA ON THE GOLD COAST AND THE METHODS BY WHICH THIS LOSS MAY BE CURTAILED.

By A. W. J. POMEROY

In breaking up nests of termites, gelignite has been found to be the most effective explosive. "Holes are drilled in the nests by means of a specially constructed hand auger, being arranged around a central perpendicular hole three feet six inches deep while the lateral holes are three feet deep and drilled at an angle of forty-five degrees (45°). The charge in the central hole is provided with a longer fuse so that this explosion takes place last allowing the charge to form a crater in the centre."

After the nests have been blown up the fumes from a cylinder of burning sulphur and arsenic and hydrocyanic acid gas can then be introduced into the broken nests. After fumigation the ground is treated with some such poison as sodium arsenite, sodium cyanide, or arsenic mixed with dry earth or road dust.

In heavily infested buildings calomel has proved to be an effective poison. Poisoned baits consisting of waste wood saturated with 10 per cent sodium arsenite may be tried also. (The Journal of the Board of Agriculture of British Guiana.)

Sugar.—The Sugar Experiment Station in East Java has developed a new variety of sugar cane, 2878 POJ, which is said to withstand common diseases of sugar cane. (Foreign Crops and Markets, December 19, 1927.)

The tobacco defense law of Cuba provides for the creation of a defense and propaganda commission which will undertake the publication of a book on native tobacco and the negotiation of treaties providing protection for "Havana" and "Vuelta Abajo" cigars.

Apropos of this there is a new tariff in Cuba which forbids the introduction of any cigarettes or tobacco containing any ingredient other than tobacco. American cigarettes are affected by this new ruling. (Tobacco, December 22, 1927.)

THE PREVENTION OF INSECT ATTACKS IN GARDENS

(Journal Royal Horticultural Society, August, 1927)
By G. F. WILSON

So as not to discourage natural bird enemies of insects, hedges should not be displaced by fences, and woodlands should not be destroyed. Besides spraying, which, when done before pests are noticed, is ineffective, the following measures will prevent insect attack: (1) Conversion of the surroundings of garden land into cultivated land. (2) The planting of trap crops, such as cabbages, between waste land and cultivated areas to intercept migrating caterpillars. (3) The careful selection of nursery stock, and the planting of resistant varieties. (4) The destruction of crop remains and rubbish which may harbor pests. (5) The banding of trees and shrubs with grease. (6) The frequent inspection and treatment of hedges and shelter belts. (The Review of Applied Entomology, Vol. 15, Ser. A. Part 12. December, 1927.)

METHODS USED TO OBTAIN SEEDLING CANES IN HAWAII

By J. A. VERRET ET AL.
Before Sugar Technologists Association of India, November 27, 1927

Freshly cut tassel-bearing stalks are preserved in a 0.03 per cent solution of sulphurous acid. Those that are intended for selfing are isolated; and those for crossing kept near one another. This procedure does not require synchronization of the period of receptivity of the stigma and the dehiscence of pollen. The only attention that is required after contact of the tassels is effected is the replenishing of the solution. After 10 days the male tassels are collected, and the female tassels placed in bags, allowed to dry for a few hours, and then planted to germinate. (Facts About Sugar, January 7, 1928.)

BOOK REVIEW

WARCOLLIER, G. El manzano de sidra y la sidrería. (Enciclopedia Agrícola.) 600 pp. Salvat Editores. Barcelona, 1925.

A complete and comprehensive treatise on cider apples and the manufacture of cider, with information on the cider apple-producing regions of Europe, the status of the cider industry and its future. The culture, including nursery and orchard practices is ably taken up.

Contents.—Distribution of cider apple in Europe; cider industry of Europe; culture of cider apple (including nursery and orchard practices); transplanting; fertilizers; harvesting; diseases and pests, and methods of control; different cider apple varieties; cider pear; composition of the fruit; cider manufacture including fermentation; cider conservation; different methods of cider making; different kinds and preparation of cider beverages or drinks (bebidas de sidra); different diseases of cider; chemical analysis of cider; pear cider manufacture; by-products in cider making; distillation of cider.

JOUZIER, E. Economía Rural. (Enciclopedia Agrícola.) 533 pp. Casa Editorial P. Salvat. Barcelona, 1923.

The role of economics, with chapters on the interrelation of land, labor, and capital, in every agricultural enterprise, is ably discussed. This is an able exposition of what agricultural economics can and should do to foster economic development, from a European point of view.

Contents.—Definition and relation of agricultural economics to the agricultural sciences; relation of agricultural enterprise to population; professional groups; the modern conception of a state; transportation facilities; agricultural instruction; taxes and public assistance; markets; the universality of competition; factors of production with a discussion on capital employed, and expenses.

Capital and its uses; immovable capital such as buildings and land; movable capital such as machinery and animals; circulating capital such as forage, fertilizers; mercantile operations, including purchase of materials and sale of agricultural products; coöperative associations; reserve capital, with a discussion on capital of amortization, insurance, and circulating capital.

Labor in its different aspects with a discussion on wages, agricultural labor contracts, labor costs; landed property and its evaluation, with a discussion on farming by administration,

tenancy and lease; agricultural credit transactions; cultural practices; organization and administration of an agricultural enterprise.

VUIGNER, R. Explotación de un Dominio Agrícola. (Enciclopedia Agrícola.) 613 pp. Salvat Editores. Barcelona, 1924.

For beginners and students of scientific and practical agriculture, this will be found very useful. How the up-to-date farmer can make the most profitable use of his farm is shown in this splendid work.

Contents.—Conditions necessary for the success of anagricultural enterprise, with a discussion on moral and physical fitness of the farmer and his wife; selection of a desirable site for the enterprise; farming by owner, administration, lease, and tenancy; taking possession of the chosen site, with a discussion on agricultural contracts and the relations of tenants or new proprietors to their predecessors.

The plant and its composition; fertilization; cultural practices; different agricultural industries; livestock farming and its advantages; improvements on the farm such as drainage, irrigation, roads, buildings, silos; motor power on the farm; agricultural implements, with a discussion on expenses and probable returns; personnel on the farm.

Accounting and inventory making; expenses; gross and net income, with a discussion on desirable ways of marketing; account books.

HOMMELL. R. Apicultura. (Enciclopedia Agrícola.) 527 pp. Salvat Editores. Barcelona, 1924.

This is at once a most scientific and practical study of honey bees. Beginners and students will find in this treatise much necessary and interesting information on raising bees.

Contents.—The bee-hive and its inhabitants, with a discussion of bee varieties, and on the anatomy of the bee; development of the bee-hive, and natural swarming (*enjambrazón natural*); beeswax and beeglue production, and construction of honey comb; pollen, water and salt requirements; study of nectar and honey; melliferous plants; general study of bee-hives and their construction; selection of a desirable site for the apiary; stamped wax (*cera estampada*) and its use; care of the bees; populating the bee-hive; care of different kinds of apiary; artificial swarming and feeding; extraction and utilization of the honey and wax; accidents; diseases and enemies.

REGNARD, P. and PORTIER, P. Higiene de la Granja. (Enciclopedia Agrícola.) 454 pp. Salvat Editores. Barcelona, 1926.

This is a treatise on sanitation on the farm, viz., in the farmhouse, in the stables, stalls, pig pens, and poultry house. Diseases affecting the farmer and his livestock, and preventive and control measures are discussed fully and clearly.

Contents.—Hygiene and sanitation in the house; wholesome and tasty food, with a discussion of the chemical composition of foods of animal and vegetable origin; sanitary water supply; sample diet.

Infectious diseases, with a discussion on bacteria; sanitary stable (*caballeriza*), with a discussion of diseases of the horse and their control; sanitary cow stalls (*establos*), with a discussion on bovine diseases, and those affecting hogs, dogs, cats, poultry, and men, and their control; hygiene in feeding quarters and sheds, with a discussion on possible animal diseases and pests that may be lurking, and treament; dog stall (*perrera*), with information on diseases and pests of dogs; hygiene in the hog pen, and diseases of hogs; poultry house, and diseases affecting poultry.

LEROUX, E. La Mimbrera, Cultivo y Aplicaciones. (Enciclopedia Agrícola.) 370 pp. Salvat Editores. Barcelona, 1926.

The culture of the willow, and the wickerwork (*cestería*) industry of Continental Europe and the United States are embraced in this most comprehensive study and forceful presentation of the international aspects of the same industry.

Contents.—Study of the willow (*Salix*); cultivated varieties; culture; fertilizers; diseases and pests; harvest and resulting treatment of the product; twisting and bending properties; imports and exports; culture of the willow, and wickerwork (*cestería*) industry of France and other countries.

Ordinary wickerwork (*cestería*) for flowers, fruits, butter, bread, clothes, cages, bicycles, valises, baby beds, baby carriages; fine and fancy wickerwork; culture of the willow in Spain and the U. S.

ANDRÉ, GUSTAVO. Química Agrícola. Química del Suelo, 2. (Enciclopedia Agrícola.) 348 pp. Salvat Editores. Barcelona, 1924.

This is a two-volume treatise on the chemistry of the soil in its relation to the practice of scientific agriculture. The work clearly indicates the mature judgment and experience of the author, himself a recognized authority.

Contents.—Introduction; formation and elements of the soil; atmospheric gases and meteoric showers (*aguas meteóricas*); physical composition; physical properties; physical and mechanical analysis; chemical composition of mineral matter in the soil; chemical composition of organic matter in the soil.

ANDRÉ, GUSTAVO. Química Agrícola. Química del Suelo, 2. (Enciclopedia Agrícola.) 319 pp. Salvat Editores. Barcelona, 1924.

Contents.—Absorbing power of soils with respect to fertilizing materials; chemical analysis of the soil to be worked; biological properties of the soil; application of the study of the chemical and biological composition of the soil; infiltration water; study of soils of autochthonous formation; classification of soils.

CAGNY, PABLO, and GOUIN, RAOUL. Higiene y Enfermedades del Ganado. (Enciclopedia Agrícola). 574 pp. Salvat Editores. Barcelona, 1924.

The hygienic care of livestock, and the symptoms and treatment of diseases that afflict them are ably discussed by the authors, who are recognized authorities. The work will prove a valuable addition to existing literature on the subject.

Contents.—Introduction; hygienic care of horses, asses and mules; diseases of horses; hygienic care of the bovines; diseases of the bovines; hygienic care of sheep and goats; diseases of sheep and goats; hygienic care of swine; diseases of swine; hygienic care of dogs; diseases of dogs; usual medicaments; preparation and application of the medicaments; poisoning; hygienic transportation of livestock; sanitary police—general measure, handling contagious diseases.

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RÉSUMÉ OF THE TWENTY-SEVENTH ANNUAL REPORT OF THE BUREAU OF AGRICULTURE

By STANTON YOUNGBERG, *Director*

CROP CONDITIONS [1]

Man and Nature combined this year's efforts and gifts to bring about the most successful agricultural year the country ever had.

Only two typhoons passed over the Islands, one during July 1926, that did little harm, but another, very destructive, in November of the same year, hit the southern region of Luzon. With this exception, the weather conditions were very favorable, as bright sunny days alternated with short periods of rains due to the presence of several typhoons that hovered near the Islands without touching them.

The usual diseases and plant pests due to the vast area of uncultivated lands and an exuberant jungle threatened the crops, but the combined efforts of the farmers and the personnel of the Bureau of Agriculture succeeded at least in considerably diminishing the damage done where it was not entirely prevented with the result that the farmers were able to obtain not only increases in the area planted to all their crops over the areas planted in the preceding year, with the one exception of abaca, but also made several crop records both in bulk and per unit area.

The prices paid were generally lower than those in the preceding year, but these were more than offset by the larger yields obtained. In fact the total returns from the leading crops of 1927 have never been exceeded except during the periods of inflated values in 1920.

PALAY (ROUGH RICE)

During the last three years, rice had consecutively produced record crops. In 1925 the yield reached a higher mark than ever before registered, totaling 45,652,600 cavans. But this

[1] To conform to the crop seasons of the different products, the crop statistics given everywhere in this report are for the agricultural year ending June 30, 1927.

amount was exceeded in 1926, by 2,127,400 cavans, being 47,780,000 cavans, and in 1927 there was a further rise to 49,946,400 cavans, an increase of 4 per cent over the crop of 1926 and 9 per cent above that of 1925. There were, it is true, larger areas planted, at least during the last two years, to partly account for these substantial increases, but favorable weather and better farming systems contributed in no small measure to this success, for the yields per hectare in 1925, 1926 and 1927 were 26.46, 27.21 and 27.64 cavans, respectively, against 25.09, the annual average for the five years preceding 1925.

The area planted to rice was 1,725,500 hectares in 1925, 1,755,920 in 1926, and 1,807,060 in 1927, while the annual average for 1920–24 was 1,646,700 hectares.

The prices paid for these crops did not change materially during the three years mentioned, for while the average during 1925, was ₱4.20 per cavan, that for 1926 was 7 centavos higher and that for 1927 was 18 centavos lower; and the total values of the crops were ₱192,179,270, ₱204,051,110 and ₱200,970,720, respectively.

The interesting feature of the progress registered by this crop is the fact that the country is steadily becoming more nearly self-supporting as regards its chief article of diet; for the large quantities of this staple that were annually imported to make up for the local shortage have been steadily decreasing.

The following shows the annual production of palay and the importation of cleaned rice since 1910.

Years	Production *Cavans*	Importation *Cavans*
1910	18,859,090	3,431,760
1911	20,530,100	3,194,343
1912	11,622,470	5,235,778
1913	24,498,860	1,512,862
1914	22,736,810	1,685,591
1915	17,818,490	3,798,983
1916	20,878,860	3,301,488
1917	28,276,720	2,556,273
1918	35,795,050	3,195,331
1919	33,781,650	883,804
1920	36,343,810	1,344,945
1921	41,478,540	1,035,266
1922	43,436,830	735,563
1923	43,790,500	1,155,635
1924	41,570,700	2,627,979
1925	45,652,600	1,759,981
1926	47,780,000	1,225,807
1927	49,946,400	211,562

SUGAR CANE

With the sole exception of the 1925 record crop, the sugar harvest during 1927 was the largest ever registered.

There were 237,350 hectares put under cultivation in 1927 as against 231,840 in 1926 and 239,470 in 1925 and the yields were 10,434,910 piculs of sugar and 564,750 piculs of panocha in 1927, as against 8,195,370 and 516,020 piculs respectively in 1926 and 10,659,480 and 521,030 piculs respectively in 1925. There were slight decreases in the production of basi during the three years mentioned. In 1925, the yield was 4,315,210 liters, which dropped to 4,298,790 liters in 1926 and to 4,066,020 liters in 1927. The production of molasses did not change materially, totaling 4,833,860 liters in 1925, 5,935,540 in 1926 and 4,365,550 in 1927.

The ever-increasing number of sugar centrals in these Islands is placing this industry on a better basis and, of course, there is noted a remarkable increase in the yields of sugar per hectare. The average annual yield for 1910–19 when there were few centrals in these Islands was 31.40 piculs per hectare, while in 1923, it was 46.69; and 46.34 in 1927. Weather conditions during 1926 were not favorable, but still the yield was 37.57 piculs or 20 per cent larger than the average for 1910–19.

Prices for sugar were higher in 1927—₱10.38 as against ₱8.89 in 1926 and ₱10.06 in 1925—but lower for panochas—₱7.65 per picul as against ₱8.32 in 1926 and ₱8.39 in 1925.

Basi brought ₱13.71 per 100 liters in 1927, ₱15.36 in 1926 and ₱15.49 in 1925. Molasses was sold at ₱10.03 per 100 liters in 1927; ₱9.15 in 1926 and ₱9.11 in 1925.

The aggregate value of all sugar cane products totaled ₱113,591,090 in 1927 as against ₱78,401,990 in 1926 and ₱112,729,900 in 1925.

COCONUTS

Most substantial increases in yield during 1927 were registered by coconuts and coconut products. In fact the year 1927 was a record one for this crop.

The production of coconuts and copra is steadily increasing every year and the rate of increase seems certain to rise for there is a general tendency to extend the areas planted to coconuts, letting them encroach upon other crop areas, especially abaca, in view of the increasing demand for vegetable oils and the new uses found for copra and coconuts.

At the end of the agricultural year 1927 there were 94,877,740 coconut trees planted, 58,414,390 of which were in bearing, tuba being distilled from 455,000 and the rest being young, as against 91,908,700, 54,650,430 and 465,790 respectively at the end of 1926.

There were 1,800,027,000 nuts gathered, an 11 per cent increase over the number gathered during 1926, which was 1,627,379,000 nuts.

The making of desiccated coconut is a fairly new industry that is rapidly developing in these Islands, and this considerably increased the consumption of coconuts during 1927 over 1926. The number of fresh coconuts used for this industry and to eat during the year 1927 was 160,276,000 as against 148,759,000 in 1926, or an increase of 8 per cent.

There was, too, a remarkable increase in the production of copra of from 5,780,700 piculs in 1926, to 6,484,750 piculs in 1927, or an increase of 12 per cent.

Coconut oil (home made) and tuba also registered increases of about 10 and 9 per cent respectively over the production of 1926. The figures for coconut oil and tuba were 1,973,710 liters and 107,772,910 liters respectively in 1927, as against 1,787,810 and 99,001,810 in 1926.

Except as for tuba, prices were lower during 1927. Coconuts sold at ₱3.84 per 100 in 1927 as against ₱4.17 in 1926. Copra brought ₱9.95 per picul in 1927 against ₱11.28 in 1926. Coconut oil sold at ₱0.44 per liter in 1927 but at ₱0.47 in 1926, and tuba at ₱0.097 per liter in 1927 against ₱0.092 in 1926.

The total value of coconuts and their by-products was ₱81,985,970 in 1927 and ₱81,369,370 in 1926.

ABACA

This valuable fiber plant showed during the year 1927 a reduction of 2 per cent in the area planted, of 5 per cent in the yield and of 10 per cent in the total value of the crops.

These losses were chiefly sustained in the old plantations of the Bicol region, Samar, and Leyte, where as a result the planters are seemingly losing their faith in the future of abaca and so directing their attention to the cultivation of other crops which promise better returns, like coconuts, sugar, and rice.

The total area planted to this fiber was 480,150 hectares in 1927, yielding 2,731,630 piculs worth ₱59,240,800. The corresponding figures for 1926, were 492,050 hectares with a production of 2,878,060 piculs valued at ₱65,724,830.

Prices also went down to an average of ₱21.69 per picul for 1927 as against ₱22.84 for 1926.

CORN

During the year 1927 the largest area ever registered for this crop was planted, and as weather conditions were favorable and the other usual calamities in the form of pests and plant diseases were greatly reduced, the largest crop of corn the Islands ever had was obtained.

The total area planted in 1927 was 561,430 hectares, as against 533,570 hectares in 1926, or an increase of 5 per cent and the production was 8,384,710 cavans as against 7,899,730 cavans in 1926, or an increase of 6 per cent.

The prices paid during the year were lower, the average being ₱4.14 per cavan of shelled corn, when in 1926 it was ₱4.73. Accordingly the total value of the 1927 crop was smaller, or ₱34,697,470 as against ₱37,370,300 in 1926.

TOBACCO

Tobacco registered substantial increases both in the area planted and in production. There were 83,970 hectares planted against 74,790 in 1926, or an increase of 12 per cent, while the production of tobacco leaf amounted to 1,091,660 quintals in 1927 against 988,010 quintals in 1926, or a 10 per cent increase. There was no change in price. Both years' tobacco leaf was sold at ₱12.10 per quintal.

The total crop in 1927 was sold for ₱13,180,830 and that in 1926 for ₱11,943,460.

MAGUEY

This fiber showed an increase of nearly 2 per cent in the total area planted in 1927 over that of 1926 but the production was considerably less—21 per cent.

During the year 1927 there were 34,000 hectares planted yielding 315,470 piculs valued at ₱3,838,490, while the corresponding figures for 1926 were 33,350 hectares, 400,400 piculs and ₱5,036,250.

CACAO AND COFFEE

There were very slight increases in the total number of cacao and coffee trees planted and in the yields in 1927 over those of 1926.

There were 2,042,500 cacao trees under cultivation at the end of the agricultural year 1927 of which 1,179,400 were in bear-

ing, yielding 1,089,100 kilos, which were sold at ₱1,127,600 at the rate of ₱1.03 per kilo. The corresponding figures for the year 1926 were 2,029,400 trees and 1,171,900 trees and 1,082,700 kilos at ₱1,119,400.

There were 2,533,700 coffee trees planted at the end of the agricultural year 1927, of which number 1,461,000 produced 1,209,800 kilos of coffee which at ₱0.69 per kilo brought ₱840,800. The figures for 1926 were 2,515,600 and 1,455,900 trees and 1,207,300 kilos which at ₱0.69 per kilo sold for ₱836,700.

LIVESTOCK

In view of the impossibility of completing the compilation of the data for the year 1927 in the short period elapsing between the end of the year and the date fixed for presenting this report, the figures given for animals are one year behind, that is, they are for December 31, 1926.

In spite of the fact that the minor animals like hogs, goats, and sheep registered decreases in the rate of birth, there was a general increase in the number of all animals during the year 1926.

The birth rates for carabaos, cattle, and horses increased .75 per cent, 2.85 per cent, and .43 per cent, respectively, while those for hogs, goats, and sheep fell 5.80 per cent, 6.34 per cent, and 3.49 per cent, respectively.

During the year there was also a general improvement as to the diseases, for the rate of mortality for all animals decreased .23 per cent for carabaos, 0.04 per cent for cattle, .17 per cent for horses, .33 per cent for hogs, .99 per cent for goats, and .29 per cent for sheep.

There was an increase in the consumption of meat of carabaos, cattle, and horses by .48 per cent, .60 per cent, and .38 per cent, respectively, but a decrease of .49 per cent for hogs, .66 per cent for goats, and .45 per cent for sheep.

PLANT INDUSTRY DIVISION

The division's activities, as usual, consisted mainly of plant investigational work on corn, rice, tobacco, sugar cane, abaca, fruit trees, and minor crops.

Corn.—At Lamao, the corn variety test showed the Calamba Yellow and Baluga Yellow to be the best of 12 yellow varieties and the Moro White, the Siamsiam White the best of 12 white varieties. Average yields: 25.92, 21.96, 19.52, and 17.10 cavans

per hectare, respectively. The best strain of Calamba Yellow gave 48.11 cavans per hectare against 38.02 cavans of check in the ear-to-the-row test. Considering the cost the best fertilizers were found to be bone meal, sulphate of potash, guano, barn manure and the complete fertilizers containing 3 per cent N., 1.5 per cent K_2O, and 7 per cent P_2O_5. Pop corn varieties under test are becoming well acclimatized. In the corn inbreeding test at the Ilagan Tobacco Experiment Station the White Sweet was found best of five varieties. Degeneration took place in the size and fullness of the ears as a result of the second year test, it was observed.

Forage crops.—The tests started last year were continued. Planting on paddy soil, the Balili, Buñgalon, and Barit were the best; of the nonirrigated forage crops introduced from abroad the Napier, Merker, Trinidad, and Guinea grass gave the most roughage.

Tobacco. Wrapper tobacco test (Ilagan Tobacco Experiment Station).—The 43-Philippine Sumatra led with 35 per cent wrapper. The 65-Havanensis gave 15 per cent, and the 18-Philippine Florida-Sumatra gave 15 per cent. Total yield of wrapper, filler, and binder per hectare: 1,690 kilos, 1,325 kilos, and 1,649 kilos, respectively.

General filler varieties test (Ilagan Tobacco Experiment Station).—The 6-Pampano No. 2, 2,887.50 kilos per hectare. The 10-Repollo, 2,607 kilos per hectare, and two other varieties gave good yieds.

General fertilizer test.—Sulphate of potash at the rate of 75 kilos of K_2O per hectare gave the highest yield and the ammonium sulphate and superphosphate at the rate of 20 kilos N. and 30 kilos of P_2O_5, respectively, the lowest. The variety used was the 43-Philippine Sumatra.

Spacing and hybridization experiments were carried on and the curing studies pursued.

Seasonal planting test.—The November crop gave the highest percentage of wrapper, 15 per cent and the January planting, 8 per cent. The March crop was stunted.

Growing tobacco between *Tephrosia candida* at the Sarunayan Tobacco Experiment Station yielded very fine, elastic and mostly "claro" wrapper; without shade, the leaves were fairly fine but inclined to be "colorado claro."

Lowland rice.—Seventy varieties were tested at the Rosales Rice Experiment Station and of the late varieties Murmuray yielded 87.5 cavans per hectare, Daluson, 78. Bacal and Ca-

yading each 77.5, and 5 others over 70. Among the early maturing varieties Macanening yielded 60 cavans, Cagayanes 59, and Mararniag 51 per hectare, while of the glutinous rice, Bal-latinao produced 68, Yucan 56 and Enero 50 cavans per hectare. At Alabang 27 varieties were tested and Inachupal-I proved to be the heaviest yielder with 60.29 cavans per hectare, but Lubangluay, the poorest, gave only 5.84 cavans. Of the medium late varieties, the Mancasar strain No. 3 led with 77.69 cavans, and the highest of the late varieties was the Kinalibo-II with 68.15 cavans. The trials with rice varieties from Spain, Japan, and the United States failed to give satisfactory results.

Fertilizer test on rice.—At Rosales, ammonium sulphate, superphosphate and ammophos on Sipot rice—300 kilos per hectare—brought the yield up to 66, 62, and 60 cavans per hectare, respectively, 44 cavans more than the control plot. Ammonium sulphate and copra meal gave the most satisfactory results at Alabang.

Testing for flood resistant varieties of rice.—The Pangasinan bearded lowland rice varieties, especially Bacal and Mandegoring showed considerable resistance to flood at Rosales; and at Alabang, Mangasa and Madaling Araw proved best for emergency planting after floods.

Planting mongo and cowpeas after the harvest increased the second crop of rice by 27 per cent, and 17 per cent, respectively, in an experiment using the "Cruz" variety.

"Palagad" or dry season rice.—Sipot topped the list with a yield of 69.78 cavans per hectare and Dinagat came second with a yield of 52.61 cavans at Alabang. Of the 10 varieties milled, Khao Bai Sri was classified as "Superior."

Upland rice (*Lamao Experiment Station*).—Ninety-three varieties were planted June 22 and 23, 1927—rather late—but gave very good crops, Kinastila leading with 63.13 cavans per hectare. 3 and 4 seeds per hill planted in upland rice gave the best results.

Sugar cane. Variety tests No. 1–3, plant cane (*La Carlota Sugar Cane Experiment Station*).—Of the 15 varieties, Java-247 gave the highest yield in sugar per hectare, 151.23 piculs; Badila 120.04 piculs; Luzon Purple 115.67 and New Guinea 24-A, 113.48 piculs. In the second year test of the 22 new varieties, Java-213 produced 164.4; Luzon-4, 147.96 piculs; C. A. C., 89; and C. A. C., 91. In the third test only 7 varieties were used L. C. S. C. 2/4 leading with 121.58 piculs.

Variety test No. 4 (Ratoon).—Thirteen varieties were compared, Hawaii-109 led with 129.36 piculs and New Guinea 24-A followed with 127.91 piculs. The others gave less than the check "Negros Purple" which produced 103.85 piculs of sugar.

Fertilizer test on sugar cane.—Both commercial and home-mixed fertilizers were used. Brand No. 3 of the former proved best, giving an increase of 29.19 per cent over the control. Of the home mixed fertilizers mixture B containing 10 per cent N. from ammonium sulphate, 6 per cent P_2O_5 from basic slag, and 2 per cent K_2O from sulphate of potash gave 27.82 per cent increase over the control.

Citrus.—Continued cover-cropping with *Tephrosia*, cacahuate, and patani gave increases in yields of some 86 to 48 per cent for Batangas mandarin-orange trees over the system of temporary cover-cropping. A series of fertilizer tests with ammonium sulphate and copra meal, supplemented with lime, gave very good results.

The rejuvenation experiment was continued at Tanauan. A number of good strains being advantageously used in top-working old and otherwise weak mandarin orange trees. Preservation and etherization experiments were also tried.

Coffee.—The fertilizer test with Excelsa coffee trees at Lamao was continued, as were the variety tests. Excelsa and Liberian coffee again proved to be the best yielders.

Mango.—Smudging tests were continued at Lamao with success and in Muntinlupa, Rizal. Of 95 trees smudged in November, 80 flowered.

Variety tests.—There are 849 mango plants in the orchard at Lamao among which are 97 inarched and 40 seedling Indian mangoes.

Semi-Temperate fruit trees.—Three varieties of apples, and the cherimoyas, loquats, olives, kaki, Moon pecans, Green Ischia and Brunswick figs and grapes are thriving quite well in the Baguio Acclimatization Station.

Three varietes of papaya are being raised at Lamao, the Hawaiian leading. Twenty-two varieties of bananas are being tested but it is too soon to report on these.

Root crops.—Of the 27 varieties of sweet potatoes at Lamao with which a test has been continued for yield, the three best were Mintal, American Large White, and Kinalamias.

Variety tests with ube, tugue, yautia, and gabi were continued.

Pineapples.—In the fertilizer test with pineapple the yields were in the ratio of 7 to 4 as compared with those of the check crop. Hybridization tests were continued and the crosses planted for further study.

Vegetables.—Variety tests were continued with tomatoes, 21 varieties being used in Lamao; and in Baguio, Irish potatoes, chick peas and *Aralia cordata*, a Japanese vegetable, are doing well.

At the Lamao Experiment Station, there are 2,125 miscellaneous tropical trees, consisting of 320 varieties and 200 species. Eight trees flowered for the first time but only two produced fruits.

Rubber.—Tapping experiments were continued at the Baco Rubber Plantation in Mindoro and the half-spiral method of tapping from January to November, alternate daily, once a day, in the morning, was found to give the best results, 10.4 grams of dry rubber per tree, while at the Abucay Plantation, Bataan, 9.5 grams of dry rubber were obtained by tapping daily, alternate months.

Abaca. Guinobatan Abaca Experiment Station (test continued from 1926).—The computed yield of fiber per hectare for Maguindanao was 211 kilos; for the Lausigan, 205 kilos; Puti Tomatagacan, 183 kilos; but for six varieties there was less than 100 kilos and for one, Tañgoñgon, only 18.

Plots planted to suckers gave 6.2 per cent and 2.5 per cent more than those planted to rootstocks. Tests were made at the Guinobatan station with the "Benito" knives, which are numbered by the number of teeth to the inch.

Cultural and fertilizer tests were also tried. Cotton and kapok experiments were continued at Lamao. There are 14 grafted kapok trees and 17 budded. The scions are of Java kapok while the stocks are native. Of miscellaneous fibers there is one Pochote growing from 37 seeds received from the United States Department of Agriculture in 1924, but slowly, and there are five of Balsa and eight of Pochote from seed from Mexico in 1926, besides 20 of Malabulak.

Sugar-cane investigation in Mindoro.—Planting by machine at San Jose was found to cost ₱8 per hectare and cultivating, ₱3.

Coöperative work on rice in Mindoro.—"Ramai," according to tests made, seems capable of increasing the yields by over 100 per cent and "Apostol" has been found to increase the yield

25 per cent as compared with "Pinili" and "Diamante," two local standard varieties.

Miscellaneous investigations.—A coconut investigation was made on Guimaras Island in Iloilo; another on strawberries in Trinidad, Benguet. Observations as to the vigor, productivity, and susceptibility of naturalized Arabian coffee trees found in the Mountain Province and places ranging in altitude from 1,591 to 6,750 feet above sea level showed that Arabian coffee does best from 5,000 feet up to the last named altitude. Soil and fertilizer investigations were made, and 106 soil samples analyzed with the coöperation of the Bureau of Science.

Coöperative planting experiments on miscellaneous fruit trees were continued. Farm blasting and farm machinery investigations were also made. Two thousand one hundred and ninety-five (2,195) coöperators were added to the former number—2,661.

Seed and plant introduction.—Sixty species (some duplicates) consisting of 158 varieties were introduced for trial planting in the stations of the Bureau.

Seed and planting materials and other experiment station products.—For free distribution, for coöperative trial planting, for exchange purposes (with foreign governments, firms, institutions, individuals, etc.) and for sale, through the Agricultural Extension Division, seed and planting materials with a total estimated value of ₱32,160.98 were produced.

AGRICULTURAL EXTENSION DIVISION

This division extended the scope of its activities to cover three more provinces; Ilocos Sur, Occidental Negros, and Abra. On the whole the people's interest and appreciation seem to be increasing. More nurseries are opened and more plants distributed.

Over half a million fruit trees were planted as the result of the horticultural campaign.

Since the agents have been inducing the farmers to start private nurseries it is estimated that about 680,000 seedlings were propagated in this way.

The division distributed seedlings and plant materials from the Central Office, the Singalong Propagation Station, the insular nurseries in Lipa and Iloilo and through its field men. The Plant Industry Division also furnished part of the material. The total value of seeds and seedlings distributed by the Central Office and the Singalong station was ₱23,917.64.

Singalong Propagation Station.—The following shows the plants raised at the station and the disposal made of them:

Economic plants, balance from 1926	87,473
Economic plants distributed during 1927	60,379
Economic plants undistributed	109,273

Of those distributed 3,475 were grafted (mostly mango), 712 were budded and 479 were marcotted plants. The station made 746 shipments of seeds and plants.

Mangosteen.—The experiments on the asexual propagation of mangosteen were continued. Of 22 stocks grafted, 20 grew, but none of the 17 stocks budded.

Mushrooms.—Mushrooms were grown at the station but due to unfavorable conditions their growing was found not profitable enough.

Sweet corn.—Two varieties "Country Gentleman" and "Golden Bantam" are promising.

Lipa Demonstration Station.—Coffee and citrus were the principal plants propagated. 68,087 coffee seedlings were distributed and 136,036 were available at the end of the year. A portion of the station was transferred to an adjacent site.

La Paz Demonstration Station.—The station lost a great many plants during the flood of September 1927, which made it necessary to replant. In this station more success was obtained in the grafting of lanzones than in any other. Two hundred eighty-seven grafted lanzones were distributed. The total number of plants sold was 3,235, valued at ₱1,320.50; distributed free, 3,738, valued at ₱886.60; on hand, 5,133, valued at ₱1,413.22.

Provincial nurseries.—Two more provincial nurseries, one in Abra and one in Cagayan, were added to the 14 under the supervision of this division.

Municipal nurseries.—Eleven more municipal nurseries were added to the 19 already in existence.

Producers' associations.—In spite of the educational campaign for helping the associations already organized progress was slight, the general mass of the farmers being indifferent. The Siam-na-Pinagisa Poultry Producers' Association at Talipapa, Caloocan, Rizal, was discontinued. The Nemmatan Tobacco Producers' Coöperative Association harvested only 300 fardos of poor quality tobacco due to the inclement weather. But it also produced over 200 uyones of Inantipolo palay, a variety introduced by this Bureau; and constructed a poultry house, a nur-

sery, and a pig pen and got a pair of Barred Plymouth Rocks and a Berkshire boar from the Bureau.

Vegetable project.—The agents constantly encouraged the planting of vegetables, distributed seeds and taught proper cultural methods.

Poultry project.—The work of increasing and improving the poultry industry was continued. The agents caponized 3,774 chickens and treated 845 for various diseases.

Rice project.—During the year the division distributed 312.5 cavans of various varieties of palay including 131 of Ramai, 38½ of Apostol and others giving good yields. Two hundred twelve rice coöperators secured seeds from the Plant Industry Division and other sources through the agricultural extension agents.

Fertilizers.—The use of fertilizers has been so general and widespread this year that there are now fertilizer dealers in a number of towns.

Sugar-cane project.—Twenty-six thousand ninety-six (26,096) cuttings were distributed through the Central Office and 704,068 cuttings secured through the extension agents direct. The varieties were Badila, Cebu Purple, Negros Purple, Hawaiian-109, New Guinea 24–A, Barbados, Java No. 247, Mauritius No. 1900 and Pampanga Red and White.

Tobacco project.—As last year the division had four men in Isabela and three in Cagayan engaged in this work. Lectures and demonstrations were given and circulars and posters distributed and 171 farmers given tobacco seed. Less seed was distributed than in 1926 as many farmers had saved their own; and a number that had planted wrapper tobacco obtained fair results. One grower sold one of his 6 fardos at ₱15 a fardo while the current price of a quintal (2.5 fardos first-class tobacco or 5 fardos third class) was from ₱7 to ₱8. More tobacco curing sheds were built and more cleanliness practiced in general. Prices on the whole were lower than in 1926 so more people are inclined to plant less tobacco and more food crops.

Abaca project.—Abaca rootstocks of the varieties Tañgoñgon and Maguindanao distributed in the Bicol region last year made a fair start, especially the Maguindanao. Rootstocks of Maguindanao and Itom were also distributed in Cavite but neither variety is doing well. In the Cagayan Valley, where abaca has been reported as thriving for the last three years, suckers are

being planted as fast as they become available. The agents demonstrate the method of stripping abaca, a new thing there. The division, in coöperation with the Indang Farm School is conducting trial planting. Eleven resistant varieties are being tried with and without fertilizer.

Dynamiting.—In and around Manila the division has resorted to dynamiting holes for fruit trees with good results. Requests for this work increased very much, so two men were assigned thereto.

PLANT PESTS CONTROL DIVISION

For 1927 no administrative orders were promulgated by the Director of Agriculture, but on June 14 an order was issued under the provisions of Administrative Order No. 29, setting forth the conditions whereby plant materials may be permitted to enter the Philippines.

Contributions and gratuities.—Twenty-three thousand four hundred pesos (₱23,400) was allotted to the provinces from the contributions and gratuities funds of this division to assist them in the control of pests and diseases. At the end of the year there was a balance of ₱43,278.87 available for this work. Most of the collections were taken up in the provinces through the enforcement of Sections 14 and 15 of Act 2472 and special appropriations were made by the provinces themselves.

Provincial locust campaign.—Summarizing the work done for the control of locusts throughout the Islands, it is gratifying to note that the people, under the direction of the municipal and provincial officials, the Constabulary soldiers and locust inspectors, all worked energetically to save the crops.

Provinces infected with locusts during the year	18
Provinces freed from locust infestation during the year	12
Provinces still infested at the end of the year	6
Total number of municipalities infested during the year	134
Total number of municipalities freed during the year	108
Total number of municipalities still infested at the end of the year	26

Locust scouting.—Locust scouting was pushed energetically during the first nine months of the year, especially to free Bohol and Mindoro, which have been infested for the last five years and are the sources of infestation for the Visayas and Luzon. They were finally cleaned up about the end of April and May respectively.

Scouting work was done in the provinces of Bohol, Cagayan, Isabela, Mindoro, Mountain Province, Nueva Ecija, Nueva Viz-

caya, Negros Oriental and Tayabas. The expenses that were incurred in this work totaled ₱99,911.38. Two aeroplanes, costing ₱3,150 and ₱2,365, respectively, were used in Bohol. Because of overdraft in the locust scouting funds as provided by Act 5163, this division was obliged to gradually disband the personnel paid from this item from September 15 to December 15, 1927, when scouting was completely stopped.

SURVEY AND ERADICATION OF COCONUT BUD-ROT AND OTHER PESTS AND DISEASES OF COCONUTS

Inspection, field survey, extension and control work.—Most of the time and efforts of the members of the staff was as usual taken up attending to the numerous complaints about insects, pests and plant diseases from all parts of the Archipelago.

Entomological and phytopathological research work.—Both field and laboratory studies of the tobacco leaf folder, the most serious pest of tobacco seedlings in the Cagayan Valley were made, as also observations on the citrus leaf miner, the mango twig borer, the Mediterranean flour moth, the rice borers, the cabbage moth, diamond back moth, etc. Research work on diseases of abacá, bananas, Hevea rubber, rice and tobacco were the major activities.

Visiting scientists.—Among these was Dr. Shuta Kinoshita, chief entomologist of the Imperial Agricultural Experiment Station, Tokyo, Japan, who is chiefly interested in the parasites of the rice borers.

Abacá and banana diseases.—Since the publication of the Bureau of Agriculture Circular No. 190, the tentative conclusion has been reached that "bunchy-top" and "heart rot" of abacá are the same, the latter being the final stage. The primary cause of bunchy-top is now thought to be a filterable virus.

Variety tests showed that a number of abacá varieties were partially resistant and Canton and Pacol immune. The use of calcium phosphate or potassium sulphate fertilizers increased resistance to the disease, but fertilizers containing nitrogen only were not satisfactory. The aphid which transmits bunchy-top also appears responsible for the spread of banana bunchy-top.

Pineapple diseases.—Much attention was given to a serious pineapple fruitlet rot. The results have been submitted for publication in the Philippine Journal of Science.

Rice disease.—Field investigations were made of sclerotial stem rot and laboratory studies are in progress thereon.

Rubber diseases were found to be negligible.

Tobacco diseases.—Investigational work on tobacco diseases was limited to a bacteriological disease which appears to be wildfire. General field observations were made and laboratory study undertaken of a green spot on Sumatra wrapper at the Serunayan Tobacco Experiment Station.

Coconut diseases (other than bud-rot), those of sugar cane, corn, rice, citrus, coffee and cacao and diseases of more or less importance of other fruits, vegetables and plants were attended to. One hundred thirty-four record pathological diagnoses were made.

Survey and eradication of abacá pests and diseases.—In Davao, this work was resumed in September and conducted in Tayabas during the early part of the year.

RURAL CREDIT DIVISION

Inspection and supervision.—The entire Archipelago was subdivided into 11 districts but two important districts have no permanent agents for lack of personnel.

New associations.—Three new associations were organized: San Remigio, Cebu; Catmon, Cebu; and Carmen, Cebu. The association of San Carlos, Pangasinan, was reincorporated with ₱15,000 capital.

This division could easily increase the present number of associations but refrains from doing so for lack of sufficient personnel to supervise them.

Collection of overdue loans.—Good results were obtained along this line. Some cases had to be taken into court but no sooner is one delinquent borrower sued than others pay their debts. As a rare exception, a number of delinquent borrowers tried to defy the authority vested in a duly elected board of directors in an association of Pampanga. In an illegal election they put in a new board of directors and by court proceedings tried to accuse the five honest directors. The case having been decided by the Court of First Instance in favor of the present administration was appealed to the Supreme Court.

THE ADMINISTRATION OF THE RICE AND CORN FUND

At the close of business, December 31, 1926, the amount of uncollected debts from the associations totaled ₱758,672.17.

Uncollected during 1927	₱130,303.87
Total loans renewed	750,131.04
Total loans granted (incl. additional loans)	138,845.00

Only six associations out of 244 that owed the Rice and Corn Fund were sued or threatened with suits; and out of these, six court cases only were formally presented, and even these associations paid their debts before the date of the trial came.

Progress during the year was, in many cases, satisfactory.

PROBLEMS YET UNSETTLED

Additional bonding of the municipal treasurers.—All municipal treasurers acting as ex-officio treasurers of the associations were additionally bonded in the Fidelity Fund.

Absence of authority to correct evils.—Where the supervisory authority of the Director of Agriculture has been recognized, this office has been able to get relatively good results; but where this Bureau was unable to exercise any control over the affairs of an association, it could only give advice.

A Philippine Rural Credit Paper.—A pamphlet has been prepared with this title which is a compilation of all rural credit laws, circulars, and forms.

ANIMAL INDUSTRY DIVISION

VETERINARY SECTION

Importation from foreign ports.—Two thousand one hundred eighteen cattle arrived at the port of Manila during the year, from Pnom-Penh, 8,319 from Australia, and 356 carabaos from Pnom-Penh; and 1,134 carabaos, 70 cattle, 3 hogs, and 5 other animals, entered the port of Iloilo.

Interisland shipments.—Fifteen thousand seven hundred thirty-eight cattle and 2,615 carabaos arrived at Manila from interisland ports, 3,454 cattle and 459 carabaos more than in 1926.

Inspection for which fees were collected.—A total of 152,849 animals of all kinds were inspected upon arrival at Manila, for which fees amounting to ₱20,401.70 were collected. Of these animals 120,797 were swine.

Postmortem inspection in Azcarraga Abattoir.—There were 131,171 animals of all kinds inspected, of which 129,786 were passed for food and 1,385 condemned. The number inspected included 115,678 swine.

Postmortem inspection in Pandacan Matadero.—One thousand seven hundred twenty-one animals were slaughtered at this matadero, 1 was condemned and 1,720 passed for food.

Postmortem inspection in Sisiman Matadero.—At Sisiman 7,966 Australian cattle were slaughtered and 62 were condemned and 7,904 passed for food.

COMBATING ANIMAL DISEASES

Rinderpest.—Three thousand thirteen cases of rinderpest were reported with 2,123 deaths.

Rinderpest cases and deaths by quarters

Period	New cases	Deaths
First quarter	786	500
Second quarter	918	705
Third quarter	948	654
Fourth quarter	361	264
Total	3,013	2,123

The provinces that suffered most were Ilocos Sur, Pangasinan, and Iloilo. The infection there remained over from the infection in 1926.

Anthrax.—Sporadic cases of anthrax occurred during the year in Bulacan, Cavite, Laguna, Nueva Ecija, Pampanga, Rizal, and Tarlac. The total number of cases and deaths were 327 and 301, respectively, representing a reduction of 323 cases, 301 deaths as compared with the cases and deaths registered during the previous year. Whenever an outbreak occurred vaccination of all the carabaos and cattle in the infected barrio was done. A total of 43,777 carabaos and 4,900 cattle were vaccinated.

Hemorrhagic septicemia.—The disease occurred during the year in Albay, Cebu, Ilocos Sur, Masbate, Misamis, Occidental Negros and Samar, 596 and 532 deaths being recorded, against 697 cases and 637 deaths the past year.

Surra.—One hundred forty-three cases were recorded.

Foot-and-mouth disease.—There was an extensive outbreak of this disease with a total of 24,232 cases but only 375 deaths. About 95 per cent of the cases were among carabaos.

VETERINARY RESEARCH LABORATORY

Rinderpest vaccine.—In the preparation of rinderpest vaccine, 414 head of cattle and 15 carabaos were used. In testing each lot of vaccine, a total of 94 cattle costing ₱5,551.15 were used.

A total of 2,072,750 c. c. of vaccine were manufactured during the year, equivalent to 460,611 doses at an average dose of 4.5

c. c. There was on hand, January 1, 1927, 810,700 c. c., making a total of 2,883,450 c. c. of which amount 2,240,450 c. c. was used in the campaign against rinderpest, leaving a balance on hand December 31, 1927, of 643,000 c. c. There were administered 377,473 vaccinations against 318,481 vaccinations during the year 1926.

Anti-rinderpest serum.—A total of 196,675 c. c. of anti-rinderpest serum valued at ₱3,146.80 was manufactured during the year, of which 177,800 c. c. valued at ₱2,844.80 were sold or used.

Immunity test of Pnom-Pehn cattle and carabaos.—Five shipments of cattle and carabaos totaling 864 animals received from Pnom-Pehn were injected with rinderpest virulent blood to test the effectiveness of immunization in Indo-China.

Animals immunized (simultaneous method).—Twenty-nine native cattle, 20 native carabaos and 8 Australian cattle were immunized by the simultaneous method as compared with 438 animals immunized by this method last year.

Anthrax.—Three specimens were submitted to the Laboratory. One from Dagupan, one from Batangas and one from Tarlac, proved positive for anthrax.

Vibrion septique infection.—One case was observed in a vaca that had undergone simultaneous immunization at the quarantine station at Iloilo.

Hemorrhagic septicemia.—One specimen positive for hemorrhagic septicemia was received from Antipolo.

Coccidiosis.—Two Ayrshire bulls imported by the Bureau of Agriculture for breeding purposes and sent to the Alabang Stock Farm for that purpose were definitely diagnosed as being affected with coccidiosis.

Epizoötic lymphangitis.—Laboratory examination of nodules obtained from a horse in Santo Tomas, Batangas, and from a rig pony owned by the Bureau of Agriculture both proved positive for this disease. The horse owned by the Bureau of Agriculture is now being experimentally treated with mercuric iodide given intravenously by Major R. A. Kelser, V. C., U. S. A. Encouraging results are being obtained.

Osteomalacia.—One case of this disease occurred in a Welsh pony used for stud purposes at the Alabang Stock Farm. This horse was so badly affected that it was necessary to destroy him.

Hog cholera and swine plague.—There were but two outbreaks of hog cholera. One severe outbreak of uncomplicated hog cholera occurred on the premises of a public institution in Rizal

Province. The other, which was found to be complicated with swine plague, was on a large farm within the city limits of Manila. In both instances a definite diagnosis was established and immunization of the well animals advised.

Tuberculosis.—Meat dealers at the Azcarraga Matadero having questioned the decision of the meat inspector who condemned hogs for tuberculosis, specimens were submitted to this laboratory for examination.

Edematous vulvitis.—One case of this disease was observed in a cow belonging to an owner in Manila. This disease has but newly been reported in the United States.

Rabies.—During the year 23 brain specimens were submitted for examination. Of this number, 7 were positive.

Fowl cholera.—Specimens of dead fowls submitted by three poultry raisers in the City of Manila and one from Malabon, Rizal, proved positive for fowl cholera on postmortem, cultures and transmission experiments.

Forage and forage crops.—As in former years, the principal green forage grasses grown in the laboratory fields were Guinea grass, Napier grass, Japanese cane, and corn.

Small animals.—The laboratory has continued to be successful in raising guinea pigs, which are used for routine vaccine and virus blood tests as well as for general laboratory diagnosis purposes.

Improvements in building and equipment—Advances in sterility of manufacture—Economies effected.—Marked improvements along these lines were made during the year. Concentration of vaccine processing operations in consecutive order in one building was effected by the construction of three appropriate rooms adjacent to the operating room. The giant steam sterilizer made according to special design late last year has proved satisfactory. Another piece of apparatus designed at the Pandacan Veterinary Research Laboratory is now being made at the Bureau of Commerce and Industry. It is expected to markedly increase the efficiency of these operations.

In order to safeguard the purity of virus and vaccine, purity (safety) tests were inaugurated this year on each lot to assure positive knowledge of freedom from disease-producing contaminating organisms.

Important economies were effected during the year.

Vaccine sub-station.—A new branch laboratory for diluting vaccine was opened at Vigan, Ilocos Sur.

Research.—The major project this year was the continuance of research on the improvement of rinderpest vaccine, which work was started last year by Major R. A. Kelser, V. C., U. S. A. and the Bureau of Agriculture working in collaboration. At this writing, laboratory experimentation is drawing to a close, the results of actual tests on cattle and carabaos indicating that a new method of preparation has improved the vaccine in three important ways: firstly, the time of preparation has been shortened from two to three months to seven to eight days; secondly, the maintenance of potency in storage has been increased from four to six weeks, to one year or more; thirdly, the immunization which has been obtained with one injection as compared with three to six injections with the old vaccine.

Animal disease control education.—The first public demonstration showing the method of manufacture and administration of rinderpest vaccine was held in the Philippine Carnival, Manila, February 12 to 27, 1927, a booth having been secured in connection with the Livestock Show. Methods of controlling disease were shown by means of booklets, charts, specimens, lantern-slides and lectures. Public interest prompted similar exhibits at Iloilo, Silay, and Ilagan carnivals during the year. Animal disease control education was also promoted by means of newspaper articles, lectures given in public schools, and radio lectures given by members of the division.

Iloilo Quarantine Station.—The laboratory shed has served as the rinderpest vaccine sub-station for the provinces in Panay Island and Occidental Negros Province. Only 1,134 carabaos and 70 cattle were received at this station from Pnom-Penh.

Sisiman Matadero.—Of the 7,966 Australian cattle slaughtered, 62 were condemned, and 7,904 passed for food.

ANIMAL HUSBANDRY SECTION

As usual the personnel gave pratical demonstration on the care of livestock and performed castration and caponization free of charge and instructed the public by lectures (radio and other) and by articles and letters.

The total income from the sale of livestock, eggs, etc., was ₱20,114.50; the estimated value of stock not sold, ₱6,010; the estimated increased value produced in the public breeding service, ₱56,215.

The Bureau assisted poultry raisers by acting as intermediary in the disposal of over 1,500 Cantonese and pure bred chickens. Less than 200 of other livestock were sold.

At the Carnival Livestock Fair on February 12–27, 1927, the Bureau exhibited pure bred and mestizo animals in competition with those of the College of Agriculture and private concerns and got most of the blue ribbons. Many animals were sold there at very good prices. Bids for ₱800 to ₱1,500 were offered for Sultan, a young mestizo pony, but he is reserved for public breeding work.

Alabang Stock Farm.—The area planted to rice and forage was again increased. An allotment of ₱2,971 was made for alterations and repairs of buildings, but many more need repair.

Cattle.—Great care was given the two Ayrshire bulls newly imported from Australia. Nineteen cows were bred to the old bull but only one to the young bull, the two Sussex bulls intended for use in a preliminary test for beef cattle improvement are at Alabang temporarily, being crossed with Indian cows. Later they will be transferred to La Carlota.

Horses.—Horse raising at Alabang is satisfactory. The Arabian stallion served 15 mares and there are 2 colts and 3 fillies that are the get of the bay stallion. Three privately owned mares have been served by this stallion and 7 have dropped their foals. The Welsh pony sent to the Mountain Province for public breeding purposes died soon after his return to the farm. He produced 6 female and 3 male foals at Alabang and was bred to 21 mares in the Mountain Province.

Sheep and goats.—There are 2 herds of goats, one headed by a Nubian buck and the other by a pure old Indian buck and the pure old Spanish buck. Mestizo Nubian bucks replaced the old bucks about the end of the year. The sheep flocks are headed by pure Shropshire rams.

Swine.—The Poland-China seem the hardiest and are crossed with native Batangas and Jalajala sows. (Results will be published later.) The Poland-China boar last imported promises to be the biggest boar the station has ever had. All his get are vigorous and well liked by the public.

Poultry.—The work on poultry has been the same as usual. During the dry season the incubator cellar was sprinkled and the incubators provided with moist sand. This increased the percentage of chicks hatched. In general the fowl project was satisfactory but the demand is too great and new fowls should be imported yearly particularly to prevent too much inbreeding.

The kamala for worms proved good for tapeworms and somewhat so for round worms, but it did not live up to the claim

that it will increase egg production. There were less eggs in fact.

La Carlota.—The weather was too rainy from May to October and the animals could not graze enough to satisfy their hunger. Intestinal parasites made conditions worse. Many died. Many chicks died also. Public interest was evidenced by the number of animals brought for breeding and by the number of visitors.

Repairs to buildings and sheds were made to the amount of ₱1,708.50.

Cebu Animal Breeding Station.—The work is producing most satisfactory results and attracting much public attention.

Batangas Animal Breeding Station.—The stallions and bulls kept in good condition throughout the year. Stallion No. 2242 is, however, rather old and will be replaced as soon as conditions warrant. The public breeding service is very greatly appreciated in Batangas as witness the time and money people spend to bring female animals for service. Total offspring reported: 108 fowls, 201 pigs and 148 calves.

Bayombong Cattle Breeding Station.—This station raises pure Indian cattle, and loans Indian bulls to cattle owners in Nueva Vizcaya. There are 9 old bulls, 7 of which run in private herds. The other 2 left with the Bureau herd served 45 cows, 26 of which calved.

A strong typhoon blew down the quarters and cattle sheds and ₱649 was spent for the repairs.

EXPERIMENTS

Cöoperative poultry-swine station.—Besides those of the Bureau of Agriculture, there are 11 maintained by the Bureau of Education and others by the provinces and other insular institutions. Three stations severed their connection with this Bureau by buying the animals loaned to them. The Santa Barbara poultry-swine station in Pangasinan is the most progressive. The province appropriated ₱3,000 for it and the nursery in 1927.

PUBLICATIONS DIVISION

WORK DURING THE YEAR

During 1927, there was an increase in the number of new publications issued and in the total of publications distributed. The publications printed were as follows: One annual report; 4 issues of the Philippine Agricultural Review; 1 bulletin; 23 new

circulars; 18 old ones; 5 reprints; 5 miscellaneous publications; 5 posters; 1 map; and 4 issues of the "Ang Magsasakang Pilipino." The number of publications distributed was 201,909 as against 167,713 in 1926 or an increase of 34,198.

Ang Magsasakang Pilipino.—The publication of the Philippine Farmer was resumed but in Tagalog only for the benefit of the Tagalog-speaking farmers. As soon as enough funds are made available it will also be published in as many dialects as possible.

Miscellaneous agricultural information.—All important information given out by the Bureau in correspondence was compiled and issued as Volume II.

Radio lectures.—Two series of radio lectures were broadcasted and the first series of 20 published.

Miscellaneous publications.—Five other publications on miscellaneous subjects were issued during the year.

Reprints.—Five reprints from the Philippine Agricultural Review were made.

Posters.—Five posters were prepared but only the one on sugar printed for distribution; the others were exhibited at the Manila and Iloilo carnivals.

Typhoon map.—A map of typhoons crossing the Philippines for the period 1903 to 1925 was prepared from the data of the Weather Bureau.

RECOMMENDATIONS

It is earnestly recommended that in the preparation of the appropriation for this Bureau for next year, a sufficient amount be included to provide for additional technical personnel to take charge of the increasing activities of this Bureau especially in the field. This Bureau is continually receiving urgent requests from provincial officials for the services of extension agents, veterinarians, and plant inspectors, but due to its inadequate appropriation it can not comply with most of these requests. This Bureau is also in need of six statistical inspectors to check and verify statistical data furnished by municipal officials.

Our sugar technologist having resigned to accept a better offer in one of the sugar centrals, it is asked that one of our men be sent abroad to specialize on sugar technology work in the United States, Cuba, Hawaii and Java. It is also recommended that another employee be sent to Brazil and other South American countries to specialize in the production of coffee and cacao.

As previously recommended two more experiment stations, one for upland rice and another for coconuts, should be established.

In the public works appropriation for next year it is requested that allotments be provided for the following buildings badly needed by this Bureau:

(*a*) One at the Alabang Stock Farm in which to carry on the experiments on feeding swine and poultry;

(*b*) One at the same station for a dairy house;

(*c*) One at the same station for office and laboratory;

(*d*) The necessary buildings for the new rice and coconut stations requested elsewhere;

(*e*) An insectary house and an adequate building for a plant pathology and soil laboratories at the Singalong Propagation Station;

(*f*) An insect-proof greenhouse on the Plant Quarantine lot for the investigation of foreign plant diseases and pests; and

(*g*) Six adequate fumigation buildings—one for each port of entry; namely, Manila, Cebu, Iloilo, Legaspi, Davao, and Zamboanga.

It is also requested that a special fund be provided in the Budget for next year for the participation of the Bureau of Agriculture in garden days, fairs and expositions held in the provinces, as this participation is one of the effective means by which this Bureau can show the many advantages of scientific and better methods of farming.

It is also recommended as in previous years that a suitable lot of about four hectares in area somewhere in Manila or some neighboring place be acquired on which to conduct field experiments on various plant pests and diseases and to plant quarantined materials coming from abroad.

It is hereby requested that more funds be asked for printing purposes so that the "Philippine Farmer" can be published in other dialects for the benefit of those farmers who read neither English, Spanish, or Tagalog.

And lastly, it is recommended that when the Philippine Legislature meets next year (1928) its attention be invited to the need for the following legislation:

(*a*) Acts appropriating sufficient funds for the eradication of coconut pests and diseases and sugar cane and rice pests and diseases.

(*b*) An Act authorizing this Bureau to use at least 20 per cent of the gross income of the experiment stations as a revolving fund for the maintenance of the said stations in order to raise funds to enable the Bureau to make more extensive experimentation.

(*c*) An Act amending the Administrative Code incorporating a penalty for municipal officials who fail to submit the quarterly crop and livestock

reports on time or who submit inaccurate or falsified reports. This Bureau has found great difficulties in the preparation of farm statistics so necessary to agriculture, commerce and industry, in view of the fact that municipal officials have the habit of submitting the reports required from them only after considerable delay and of the further fact that many of these reports contain inaccuracies due to carelessness.

(*d*) An Act amending the Rural Credit laws so as to grant the Director of Agriculture more extensive power than that now allowed him—to make his authority commensurate with his responsibility. At present the Director of Agriculture is a mere adviser and supervisor of the rural credit associations. He can not even put a stop to irregularities in the management of the associations, as he is restrained by law from taking any drastic action to close a bad association or even remove unworthy directors.

UPLAND RICE EXPERIMENTS AT THE LAMAO EXPERIMENT STATION, LAMAO, BATAAN 1921–1927

1921

General variety test.—Seventy-seven varieties were planted in plots 5 by 10 meters in size, June 25 to July 14, 1921 at the Lamao Experiment Station, Lamao, Bataan. The seeds were 5 to 7 in number in the hills, and the space between the hills in the row was 20 centimeters, while the rows were 50 centimeters apart.

A considerable number of the seedlings were attacked by a disease that caused a gradual wilting of the leaves and rotting of the roots. Other diseases observed were the smut, mildew and another fungus disease that caused spots on the leaves. But only a little of the smut was found. The mildew was present in a portion of the plots planted to the Bandera, Binabaye II, Binicol II, Kinalangkang, Pilit Morado, White Mangasa, Capayong, and Colapdos varieties. "Mayang pula" visited the fields, in spite of the scarecrows that were put up. Fortunately, however, very slight damage was done by these birds. Rice bugs were only rarely seen in the field and the damage done by them was of no consequence.

The following named varieties were found to be the most promising: Inaslom, Buaoa, Pol-lique, Quinirispinong puti, Binagontauo, Binoguinguin, Kinacao, San Fabian, Guinaboc, Aikoku, Guimat, Inantak, Tonguitan, Bayangbang, Kapotol, Roxas, Bulao, Nagsayang pula Kinanda, Sagoboy, Mangasa II, Binabaye II, Kinilay, Mayoro, Naglantik, Daliket or Sanglay, Lubang pula, Quinokong uwak, Caña Bombo, Lubang Blanco, Kinanda, Binicol II, Galong Sta. Maria, Ngapol, Pilit Morado, Binongang Loay, and Macatibos.

TABLE I.—*Variety test of upland rice at the Lamao Experiment Station for the year 1921*

Perm. No.	Variety name	Age at maturity	Computed yield per hectare, 100 per cent stand	
		Days	*Kilos*	*Cavans*
777	Sagoboy	122	1,300.00	29.55
1320	Guinamat	113	760.00	17.27
1110	Mangasa II	114	1,100.00	25.00

TABLE I.—*Variety test of upland rice at the Lamao Experiment Station for the fiscal year 1921*—Continued

Perm. No.	Variety name	Age at maturity	Computed yield per hectare, 100 per cent stand	
		Days	*Kilos*	*Cavans*
1324	Kinacao	125	1,100.00	25.00
1342	Ngapol	116	1,120.00	25.45
1329	Kinilay	123	1,020.00	23.18
	Malagoso	120	900.00	20.43
260	Caporcas I	111	920.00	20.91
1334	Pilit Morado	123	1,040.00	23.63
1318	Galong Famy	118	560.00	12.73
1314	Cuoab	119	680.00	15.46
1048	Inintiw	110	800.00	18.18
	Macan II	110	580.00	13.18
1244	Cainti	112	680.00	15.46
1485	White Mangasa	114	760.00	17.27
1319	Galong Santa Maria	132	1,000.00	22.73
1326	Kinanda	112	1,320.00	30.00
644	Nagsayang Pula	123	1,500.00	34.09
966	Daliket	111	1,060.00	24.09
520	Lubang pula	112	1,160.00	26.36
1332	Naglantik	117	1,160.00	26.36
1103	Lubang blanco	120	1,280.00	29.09
1139	San Fabian	116	1,180.00	26.82
282	Caririt	128	700.00	15.91
1302	Binagacay	128	560.00	12.73
1216	Kinandang pula	113	740.00	16.82
205	Colapdos	127	640.00	14.32
262	Kapotol	116	2,020.00	43.64
1311	Carabao	137	180.00	4.09
448	Inaslom	118	1,040.00	23.63
613	Mayoro	127	1,040.00	23.63
1181	Pol-lique	119	1,700.00	38.63
81	Binalintin	122	580.00	13.18
1321	Guinan	125	580.00	13.18
1284	Guinaboc	146	1,520.00	34.55
1312	Capayong	120	940.00	21.36
120	Bulagsac	110	760.00	17.27
937	Binicol II	123	1,260.00	28.63
	Bulao IV	109	1,368.00	31.09
1304	Binongang loay	131	1,360.00	30.93
1361	Binoguinguin	125	1,020.00	23.18
620	Minantica I	130	640.00	14.54
572	Malido	130	680.00	15.45
1339	Tonguitan	115	1,380.00	31.36
1489	Inantak	125	1,160.00	26.36
1299	Bayangbang	121	1,740.00	39.54
1279	Bandera	123	800.00	18.18
229	Calonod	124	540.00	12.27
1335	Quinirispinong Puti	110	1,020.00	23.18
1313	Carawin	111	2,020.00	23.18
	Caluis	125	560.00	12.72
980	Kinastila IV	116	920.00	20.91
1125	Pinili a biit	140	520.00	11.82
1309	Caña Bombo	124	1,600.00	36.36
338	Dali	131	880.00	20.00
1341	Buaoa	114	1,000.00	22.72
78	Binagontauo	115	1,000.00	22.72
1330	Layag	116	960.00	21.32
	Dap-pog	107	580.00	13.18
67	Binabaye II	118	1,040.00	23.67
1283	Menita	122	940.00	21.36
1346	Kinalangkang	123	740.00	14.54
1343	Quinokong Uwak	123	1,160.00	26.36
1340	Unoy dagoydoy	114	860.00	19.54
1317	Dinolores	125	780.00	17.72
1097	Initlog dalag	125	420.00	9.54
	Piniling Malatiit	125	580.00	13.18
1332	Guimat	115	1,220.00	27.72
1004	Roxas	138	1,240.00	28.18
956	Inantipolo II	126	680.00	15.75
1217	Kinandang puti	111	640.00	14.54
1333	Luyot	116	900.00	20.45
958	Macatibos I	126	1,040.00	23.67
1488	Casogsong	(a)	(a)	(a)
	Cabijud	126	640.00	14.51
1353	Aikoku	138	1,580.00	35.97
306	Catorsa	125	560.00	124.2

[a] Failed to produce marketable grains.

1922

General variety test.—In the preceding year's cultures only 77 varieties were studied but this number was raised to 210 and included those received from La Carlota Experiment Station and those varieties collected locally.

About 10,250 square meters of land was used for this culture. It was fairly well prepared and divided into plots of 5 by 10 meters (50 sq. m.). The plantings were made from June 17 to June 29, 1922, inclusive, at a distance of 30 by 20 centimeters with 3 or 4 seeds to a hill. Germination took place from June 22 to July 5, 1922.

A month after, that is, when the seedlings were about 30 centimeters high thinning was done, only one vigorous plant being left to each hill. This culture was weeded twice by hand and with garden hoes.

Table II indicates the behavior of each variety tested during the year.

TABLE II.—*Variety test of upland rice at the Lamao Experiment Station for the year 1922*

Perm. No.	Variety name	Age at maturity	Actual yield	Computed yield per hectare	
		Days	*Kilos*	*Kilos*	*Cavans*
1320	Guinamat	124	1.16	232.00	5.32
937	Binicol II	126	1.24	248.00	5.61
613	Mayoro I	126	.93	186.00	4.26
1343	Quinokong uwak	130	.28	56.00	1.29
520	Lubang Pula	126	1.78	356.00	8.16
260	Caporcas I	119	.64	128.00	2.93
1339	Tonguitan	117	1.14	228.00	5.22
1313	Carawin	127	3.25	650.00	14.90
980	Kinastila IV	(a)	(a)	(a)	(a)
1330	Layag	117	.75	150.00	3.44
958	Macatibos I	130	2.02	404.00	9.26
1383	Menita	129	1.57	314.00	7.20
1332	Guimat	112	.65	130.00	2.98
1312	Capayong	138	(b)	(b)	(b)
448	Inaslom	129	(b)	(b)	(b)
1348	Gubas IV	108	(b)	(b)	(b)
338	Dali	(a)	(a)	(a)	(a)
1340	Unoy dagoydoy	116	1.16	232.00	5.32
1334	Pilit morado	118	2.70	540.00	12.38
1181	Pol-lique	125	(b)	(b)	(b)
67	Binabaye II	128	2.69	538.00	12.34
78	Binagontauo	128	(b)	(b)	(b)
1110	Mangasa II	127	(b)	(b)	(b)
1324	Kinacao	131	2.27	454.00	10.41
1342	Ngapol	127	.92	184.00	4.22
1326	Kinanda	132	.98	196.00	4.50
1004	Roxas	(a)	(a)	(a)	(a)
1332	Naglantik	128	2.92	584.00	13.39
644	Nagsayang Pula	135	3.64	728.00	16.69
1299	Bayangbang	133	2.23	446.00	10.22
1319	Galong Sta. Maria	132	(b)	(b)	(b)
1139	San Fabian	136	2.04	408.00	9.35
1335	Quinirispinong Puti	137	2.55	510.00	11.69
1489	Inantak	133	2.98	596.00	13.67
1361	Binoguinguin	123	3.24	648.00	14.86
1309	Caña Bombo	132	2.23	446.00	10.22
1353	Aikoku	135	2.79	558.00	12.79
1333	Luyot	120	.72	144.00	3.30
966	Daliket or Sanglay	(b)	(b)	(b)	(b)
1329	Kinilay	138	2.22	444.00	10.18

[a] Failed to produce crop. [b] Very few panicles produced.

TABLE II.—*Variety test of upland rice at the Lamao Experiment Station for the year 1922*—Continued

Perm. No.	Variety name	Age at maturity	Actual yield	Computed yield per hectare	
				Kilos	Cavans
		Days	*Kilos*	*Kilos*	*Cavans*
1304	Binongang Loay	129	4.61	922.00	21.14
1284	Guinaboc	134	2.57	514.00	11.78
1103	Lubang Blanco	132	3.18	636.00	14.58
1279	Bandera	130	(b)	(b)	(b)
572	Malido	136	3.82	764.00	17.52
1314	Cuoab	126	1.19	238.00	5.45
262	Kapotol	139	5.00	1,000.00	22.93
1485	White Mangasa	129	2.51	502.00	11.51
1048	Inintiw	122	2.22	444.00	10.18
282	Caririt	138	2.28	456.00	10.45
120	Bulagsac				
1341	Buaoa	126	1.49	298.00	6.83
620	Minantica I	(a)	(a)	(a)	(a)
1217	Kinandang puti	113	1.26	252.00	5.77
1216	Kinandang pula	113	1.28	256.00	
205	Colapdos	138	2.98	596.00	13.67
1317	Dinolores	134	.91	182.00	4.17
987	Magdalena	129	2.30	460.00	10.55
1213	Inagsaya	136	1.09	218.00	5.00
639	Nagdami	132	1.84	368.00	8.44
1331	Mita	(a)	(a)	(a)	(a)
1298	Ban-ar	131	1.35	270.00	6.19
1188	Sekitori	(a)	(a)	(a)	(a)
1559	Cutsiam	121			
1307	Cabon	111			
1158	Cammang	124			
1382	Guinatas	107			
1287	Oag-oag	122			
1249	Nagrion	136	1.46	292.00	6.69
1166	Kinandang kumpol	137	.58	116.00	2.66
1230	Naglihim	126	1.97	394.00	9.03
362	Dinagat I	123			
1292	Early Prolific	(a)	(a)	(a)	(a)
619	Mantica Pilit	127	3.05	610.00	13.99
1252	Bangol	129	1.38	276.00	6.33
879	Tinomanan	132			
1189	Takenari	(a)	(a)	(a)	(a)
1560	Buluhan	100			
1565	Kinamantigue	137	1.89	378.00	8.67
1558	Daliket	98			
1161	Dinalaga V	124			
1315	Danilog	126	1.02	204.00	4.67
515	Lubang II	130	1.70	340.00	7.79
1350	Araw	(a)	(a)	(a)	(a)
1305	Cabayo	128	2.80	560.00	12.84
1178	Piatan	131			
970	Cayangcang	135			
1500	Macapno	134	1.51	302.00	6.92
47	Barangcal	131	1.71	342.00	7.84
1338	Tapacoy	134	2.25	450.00	10.32
1351	Oyoy	138	1.35	270.00	6.19
1290	Blue Rose I	(c)	(c)	(c)	(c)
791	Sanglay puti	125			
1348	Cadidi	138	1.12	224.00	5.13
1001	Apostol	132	2.28	456.00	10.45
1147	Cutsiam II	124	1.15	230.00	5.27
1150	Balasang	(c)	(c)	(c)	(c)
1286	Minacan	132	(b)	(b)	(b)
1288	Agsam	126	(b)	(b)	(b)
1336	Sinadyaya	(a)	(a)	(a)	(a)
1062	Bebe	126	(b)	(b)	(b)
1328	Malagayang Tapol	124	(b)	(b)	(b)
1262	Kinastila	124			
1248	Kathisod	(c)	(c)	(c)	(c)
999	Hinirang	129	3.21	642.00	14.72
1100	Lampadan or Allañgigan	120	4.16	832.00	19.08
1490	Sinaria	129	3.38	676.00	15.50
1246	Siamese Rice	(c)	(c)	(c)	(c)
951	Kalibod	130	1.64	328.00	7.52
1267	Carolina Gold II	(a)	(a)	(a)	(a)
126	Bulandi	137	2.40	480.00	11.00
1285	Kinampupoy	122	1.93	386.00	8.85
1250	Thul chalong	129	1.88	376.00	8.62

[a] Failed to produce crop. [b] Very few panicles produced. [c] Failed to germinate.

TABLE II.—*Variety test of upland rice at the Lamao Experiment Station for the year 1922*—Continued

Perm. No.	Variety name	Age at maturity	Actual yield	Computed yield per hectare	
		Days	*Kilos*	*Kilos*	*Cavans*
1325	Kinayabog	130	2.08	416.00	9.54
774	Sacsek	125	4.28	856.00	19.63
Check	....	127	2.57	514.00	11.78
1347	Caviteña a biit	126	1.52	304.00	6.97
1146	Casulig	130	1.17	234.00	5.39
1184	Ugnas	(c)	(c)	(c)	(c)
1148	Tuhao III or Caot	132	1.41	282.00	6.46
943	Bonguet	132	.82	164.00	3.76
991	Malagkit-kaawa	130	1.22	244.00	5.59
1247	Khao Bai Sri	(c)	(c)	(c)	(c)
1160	Cucuam	(c)	(c)	(c)	(c)
1133	Samban	127	.76	152.00	3.48
956	Inantipolo II	123	1.37	274.00	6.28
1386	Panay	128	1.17	234.00	5.36
1149	Bagsang	122	.96	192.00	4.40
1125	Pinili a biit	125	2.07	414.00	9.49
574	Maliro	124	2.74	548.00	12.56
1117	Minantica IV	129	(b)	(b)	(b)
1316	Dayome	133	2.35	470.00	10.77
1231	Nagoyon	127	3.24	648.00	14.86
1302	Binagacay	129	2.14	428.00	9.82
1179	Piniling	127	....	....	....
65	Binabaye	124	....	....	....
1089	Diquet a Pinasagad	(c)	(c)	(c)	(c)
254	Capichola	126	1.79	358.00	8.21
363	Dinagat II	116	....	....	....
1073	Calibug	127	2.10	420.00	9.63
718	Pulupot I	125	....	....	....
1050	Kinastila V	115	2.04	408.00	9.35
983	Buluhan	120	....	....	....
1323	Inacopañga	123	1.40	280.00	6.42
990	Kaawa	122	2.63	526.00	12.06
1328	Check	124	2.94	588.00	13.47
530	Macan Piña	126	1.22	244.00	5.59
92	Binicol I	125	.85	170.00	3.89
945	Catalong	126	(b)	....	....
1289	Amariles	125	1.26	252.00	5.77
1337	Sarocot	124	.93	186.00	4.26
1301	Bihoralog Pula	136	.54	108.00	2.47
1226	Mangasa I	127	.48	96.00	2.20
1193	Kinastila VII	125	.43	86.00	1.97
998	Macarañag II	120	.96	192.00	4.40
562	Malagaya	122	(b)	....	....
1561	Lintang anod	123	.52	104.00	2.38
1300	Berilhon	124	2.38	476.00	10.91
Check	....	....	(a)	....	....
1364	Binagontauo	123	3.04	608.00	13.94
979	Nagpunit	120	3.01	602.00	13.80
1387	Pinalengke	124	1.95	390.00	8.94
1234	Piniling Bebay	125	1.78	356.00	8.16
673	Pileng Baybay	127	1.13	226.00	5.18
1136	Sinaba III	124	1.56	312.00	7.15
1111	Mayoro II	....	(c)	....	....
1101	Langauisan	121	1.81	362.00	8.30
1310	Caponguit	128	2.85	570.00	13.07
1138	Sinampaga	122	3.82	764.00	17.52
815	Sinacoban	121	(b)	....	....
1320	Check	118	2.24	448.00	10.27
971	Kinastaño II	125	3.32	664.00	15.22
969	Binucawe	133	.96	192.00	4.63
967	Binondoc II	129	1.15	230.00	5.27
724	Putyucanon	126	1.14	228.00	5.22
New	Guinulong	127	.77	154.00	3.53
New	Bulagsac	129	(b)	....	....
New	Dinularo	134		....	....
306	Catorsa	124	1.16	232.00	5.32
229	Calonod	143	1.93	386.00	8.85
1482	Pinili	130	(b)	....	....
1329	Malagoso	127	(b)	....	....
1097	Initlog dalag	133	(b)	....	....
1308	Caluis	135	(b)	....	....
347	Dap-pog	133	(b)	....	....
1318	Galong Famy	....	(a)	....	....

[a] Failed to produce crop. [b] Very few panicles produced. [c] Failed to germinate.

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TABLE II.—*Variety test of upland rice at the Lamao Experiment Station for the year 1922*—Continued

Perm. No.	Variety name	Age at maturity	Actual yield	Computed yield per hectare	
		Days	*Kilos*	*Kilos*	*Cavans*
81	Binalintin	135	(b)		
12	Amayan	127	(b)		
777	Sagoboy	135	1.38	276.00	6.33
1244	Cainti	144	(b)		
1311	Carabao		(c)		
1188	Seketori		(c)		
1321	Guinan	115	3.34	668.00	15.32
New	Pinursigue	127	3.79	758.00	17.38
1573	Persian No. 1		(c)		
1574	Persian No. 2		(c)		
1575	California Var. No. 1600		(c)		
1294	Gopher	118	2.62	524.00	12.01
1295	Storm Proof	119	3.61	722.00	16.55
1264	Honduras	118	(b)		
1293	Edith	120	(b)		
1168	Vintuba	117	(b)		
New	Panagaraw Kabuad No. 1	(d)	(d)		
New	Panagaraw na Pula No. 2	(d)	(d)		
New	Panagaraw na Puti No. 3	(d)	(d)		
New	Dinulong	(d)	(d)		
New	Sinantamaria		1.43	286.00	6.55

[b] Very few panicles produced. [c] Failed to germinate. [d] Destroyed by atangia.

Though no diseases had invaded the field the plants suffered from drought during the month of September and for this reason many of the varieties failed to flower or produced only a few panicles.

From the table it will be noted that all the varieties gave poor results except the following: 1304 Binongang Loay, 262 Capotol, 1100 Lampadan or Allañgigan, 774 Sacsek, 1138 Sinampaga, 644 Nagsayang Pula, 572 Malido, Pinursigue, and 1295 Storm Proof, which yielded from 16 to 22 cavans or from 697 to 959 kilos per hectare each. Many of the varieties gave a very poor yield—not even enough seeds to keep the variety for the next trial planting. The low yields obtained in this test may be attributed partly to the poor preparation of the land and to the lack of cultivation.

1923

General variety test

1. Number of varieties 134
2. Area of land .... 8,650 square meters
3. Area of individual plot .... 50 square meters
4. Number of check plots 21
5. Previous crop .... Rice and kibal
6. Amount of seeds planted .... ½ liter for each plot
7. Date of planting .... June 25, 26, 27 and 28 and July 5, 6, 1923
8. Method of planting .... By the use of marker and then dropping the seeds by hand into the holes

General variety test—Continued.

9. Spacing .... 20 by 20 centimeters
10. Date of germination .... July 5–9, 1923
11. Percentage of germination .... 85 to 98 per cent
12. Date of thinning and replanting. July 28–31 and August 1–23, 1923
13. Frequency of irrigation .... Once, during the flowering season of the crop
14. Method of irrigation .... Flooding
15. Frequency of cultivation .... Once
16. Method of cultivation .... Weeding by hand with a trowel covering the base of the plants with soil by the use of hoe
17. Date of harvesting .... November 5–14, 1923
18. Actual expense per plot .... ₱0.47
19. Expenses per hectare .... ₱84
20. Results .... No results could be obtained from this test because the plants were all carried away by a flood. However, the number of days of maturity could be determined.

TABLE III.—*Variety test of upland rice at the Lamao Experiment Station for the year 1923*

Age at Maturity	Variety name
Days	
100	Pilit Morado and Daliquet or Sanglay
102	Unoy Dagoydoy and Kinandang Pula
104	Kinandang Kumpol, Edith and Apostol
106	Luyot, Minacan, Malido, Bulandi, Nagsayang Pula, and Kinandang Puti
107	Aikoku, Buaoa and Putyucanon
108	Magdalena and Cayangcang
109	Binabaye II and Oyoy
110	Inacopanga, Dayome, Sinaba III, Bagsang and Cuoab
111	Kaawa
112	Kinastila V, Vintula, Gopher, Kinastila, Menita, Sanglay, Guimat, Bihoralog Pula and Casulig
113	Carawin, Macarañag II, Guinan, Nagdami, Magpunit, Binagontauo, Storm Proof, Calonod, Sinacoban, Dinagat II, Buluhan, Amariles, Inantak, Tapacoy, Tinomanan, Kinacao and Lubang Blanco
114	Kinastaño, Nagoyon, Kinastila IV, Mita, Binicol I, Guinulong and Bonguet
115	Thul Chalong, Dinalaga V, Catorsa and Danilog
116	Kalibod and Samban
117	White Mangasa, Caporcas I, Guinatas, Binoguingin, Catalong, Pulupot, and Binondoc II
118	Piniling, Piniling Baybay, Caviteña a Biit, Pinursigue, Sacsek, Hinirang, Panay, Capichola, Kinampupoy, Binabaye, Macan Piña, Cabayo, Sinampaga, Sarocot, Tonguitan, Naglantik, Inagsaya, Pol-lique and Calibug
119	Binagacay, Buluhan, Inantipolo II, Mangasa I, Quinukong Uwak and Mayoio
120	Bangol, Blue Rose I, Maliro, Langauisan and Tuhao or Caot
121	Lintang anod, Mangasa II, Malagkit Dinolores, Quinirispinong Puti, Cutsiam II and Kinastila VII
122	Lampadan, Binucawe, Macatibos I, San Fabian and Kinanda
123	Pinalengke, Berilhon, Kinayabog, Inintiw, Caponguit, Pileng Baybay and Kinamantigue
124	Minantica, Naglihim, Inaslom, Binongang Loay, Nagrion, Capotol, Colapdos, Bayangbang, Caña Bombo, Malagaya and Barangcal
126	Pinili a Biit and Kinilay
127	Sinantamaria
128	Caririt and Piatan

Head-to-the-row test.

1. Number of varieties 5
2. Area of field .... 2,480.60 square meters
3. Area occupied by each variety.... 440 square meters
4. Area of check plot .... 44 square meters

Head-to-the-row test—Continued.

5. Number of check plots	6
6. Previous crops	Rice, cowpea, and soy bean
7. Amount planted	100 heads in 100 rows to each variety
8. Date of planting	June 12, 13, and 14, 1923
9. Method of planting	By the use of a marker and then dropping the seeds by hand into the holes
10. Spacing	Twenty centimeters between rows and 20 centimeters between plants. Only one plant to the hill
11. Date of germination	June 16 to 18, 1923
12. Per cent of germination	Varies from 80 to 88 per cent
13. Date of thinning and replanting	July 17 to 24, 1923
14. Replanting	The missing hills were replanted with plants taken from the same row
15. Frequency of irrigation	None
16. Frequency of cultivation	Once
17. Method of cultivation	Covering the base of plants with soil with a garden hoe and weeding
18. Date of harvesting	November 28 and 29, 1923
19. Actual expenses	₱56.31
20. Expenses per hectare	₱251.21
21. Results	Out of the five varieties only one was left after the flood. The performance of this variety is shown in Table IV.

The results show that the computed yield per hectare varied from 225 to 1,850 kilos.

TABLE IV.—*Performance of Kinastila rice in head-to-the-row test at the Lamao Experiment Station for the year 1923*

Row number	Average number of stalks per stool	Average number of heads per stool	Average number of white heads	Average length of heads	Average number of grain per head	Yield	
						Actual	Per hectare
				Cm.		*Kilos*	*Kilos*
1	1	1	0	17.9	56	.012	600
2	1	1	0	19.8	135	.019	950
3	2.2	2.2	0	18.7	102	.020	1,000
4	1.6	1.6	0	16.5	112	.017	850
5	1.8	1.8	0	15.8	98	.016	800
6	1.4	1.4	0	17.3	112	.0155	775
7	1.4	1.4	0	19.3	109	.015	750
8	1.2	1.2	0	19.6	115	.014	700
9	2	2	0	18.1	91	.018	900
10	1	1	0	18.7	118	.012	600
11	1.4	1.4	0	17.9	108	.0145	725
12	1.6	1.6	0	16.1	100	.016	800
13	1.4	1.4	0	17.3	115	.017	850
14	1.2	1.2	0	19.7	130	.013	650
15	1.6	1.6	0	18.5	110	.0175	875
16	1.2	1.2	0	17.0	93	.0125	625
17	1	1	0	16.9	101	.010	500
18	2.2	2.2	0	15.3	79	.018	900
19	1.8	1.8	0	15.6	83	.015	750

TABLE IV.— *Performance of Kinastila rice in head-to-the-row test at the Lamao Experiment Station for the year 1923*—Continued

Row number	Average number of stalks per stool	Average number of heads per stool	Average number of white heads	Average length of heads	Average number of grain per head	Yield	
						Actual	Per hectare
				Cm.		*Kilos*	*Kilos*
20	1.6	1.6	0	17.8	83	.015	750
21	1.6	1.6	0	17.1	86	.019	950
22	1.6	1.6	0	16.4	84	.0165	825
23	1.8	1.8	0	15.4	70	.014	700
24	1	1	0	17.0	97	.009	450
25	1	1	0	15.5	92	.008	400
26	1.4	1.4	0	18.7	108	.016	800
27	1.2	1.2	0	16.5	97	.0105	525
28	1.8	1.8	0	15.5	79	.0165	825
29	1.6	1.6	0	17.2	95	.013	650
30	1.4	1.4	0	17.5	113	.017	850
31	2	2	0	15.65	84	.017	850
32	2	2	0	13.94	78	.013	650
33	1.8	1.8	0	15.7	72	.0125	625
34	1.6	1.6	0	17.4	93	.013	650
35	1.6	1.6	0	15.3	94	.0155	775
36	1.6	1.6	0	16.1	93	.016	800
37	2.2	2.2	0	17.5	101	.0225	1,125
38	1.6	1.6	0	17.0	106	.020	1,000
39	1.8	1.8	0	17.2	91	.015	750
40	1.6	1.6	0	17.3	87	.015	750
41	1.4	1.4	0	18.1	117	.016	800
42	1.8	1.8	0	17.6	87	.015	750
43	2	2	0	17.74	90	.0175	875
44	2	2	0	16.24	77	.0165	825
45	1	1	0	19.7	169	.018	900
46	2	2	0	18.38	88	.018	900
47	2.4	2.4	0	16.7	87	.0215	1,075
48	1.2	1.2	0	18.9	125	.012	600
49	1.2	1.2	0	17.1	112	.014	700
50	2.4	2.4	0	16.7	99	.023	1,150
51	1.6	1.6	0	17.1	96	.0175	875
52	2	2	0	17.17	103	.0205	1,025
53	1.6	1.6	0	18.3	120	.021	1,050
54	1	1	0	20.0	120	.013	650
55	1.2	1.2	0	18.2	122	.016	800
56	2.4	2.4	0	16.2	105	.027	1,350
57	1	1	0	17.5	115	.014	700
58	1.4	1.4	0	17.9	85	.011	550
59	1.2	1.2	0	20.9	149	.0165	825
60	1.4	1.4	0	16.4	100	.0105	525
61	1.2	1.2	0	17.9	121	.0135	625
62	1.2	1.2	0	19.2	147	.015	750
63	1.6	1.6	0	17.4	112	.0165	825
64	2	2	0	21.63	172	.037	1,850
65	2	2	0	18.22	103	.022	1,100
66	1.6	1.6	0	22.6	213	.032	1,600
67	1.2	1.2	0	21.1	170	.0175	875
68	1.8	1.8	0	18.2	134	.024	1,200
69	1.2	1.2	0	15.8	108	.012	600
70	1.4	1.4	0	20.2	159	.023	1,150
71	1.2	1.2	0	19.5	150	.0185	925
72	1.2	1.2	0	18.6	110	.0125	625
73	1.4	1.4	0	17.4	108	.0143	715
74	2	2	0	15.87	88	.0165	825
75	1.4	1.4	0	18.3	126	.0165	825
76	1	1	0	19.3	145	.0125	625
77	1	1	0	17.8	125	.012	600
78	1.6	1.6	0	16.7	114	.019	950
79	1	1	0	16.1	110	.0105	525
80	1	1	0	15.6	85	.0045	225
81	1	1	0	16.0	90	.0075	375
82	1.4	1.4	0	16.0	75	.011	550
83	1.4	1.4	0	16.4	95	.0125	625
84	1	1	0	20.1	122	.0105	525
85	2	2	0	15.91	76	.016	800
86	2	2	0	16.64	90	.017	850
87	1.2	1.2	0	16.6	91	.010	500
88	2	2	0	15.43	64	.010	500
89	1.6	1.6	0	16.9	96	.0155	775
90	1.8	1.8	0	18.9	113	.0175	875
91	1.2	1.2	0	17.6	128	.014	700
92	1.4	1.4	0	16.3	131	.016	800

TABLE IV.— *Performance of Kinastila rice in head-to-the-row test at the Lamao Experiment Station for the year 1923*—Continued

Row number	Average number of stalks per stool	Average number of heads per stool	Average number of white heads	Average length of heads	Average number of grain per head	Yield	
						Actual	Per hectare
				Cm.		*Kilos*	*Kilos*
93	1.8	1.8	0	16.8	100	.017	850
94	1	1	0	19.6	155	.018	900
95	1	1	0	20.5	130	.0125	625
96	1.4	1.4	0	16.2	78	.0075	375
97	1	1	0	15.3	78	.008	400
98	1	1	0	21.6	172	.017	850
99	1	1	0	17	104	.0105	525
100	1	1	0	16.5	95	.007	350

1924

General variety test.—The object of the experiment was to determine the best yielding variety of upland rice adapted to local conditions.

1. Number of varieties tested............ 60
2. Area of field used............ 6,480 square meters
3. Area occupied by each variety.... 95 square meters (approximately)
4. Number of check plots............ 8
5. Previous crops .... Newly opened field
6. Date of planting............ June 20–21, 1924
7. Methods of planting............ By the use of a marker and then dropping the seeds by hand into the holes
8. Spacing .... 20 by 20 centimeters
9. Date of germination............ June 23–24, 1924
10. Frequency of cultivation............ Only once
11. Method of cultivation............ Only weeding
12. Date of harvesting............ October 27 to November 14, 1924
13. Actual expenses per variety........ ₱0.76
14. Computed expenses per hectare.. ₱84.44
15. See Table V for the results of this test.

TABLE V.—*Variety test of upland rice at the Lamao Experiment Station for the year 1924*

Permanent number	Variety name	Percentage of stand	Age at maturity	Actual yield	Corrected yield at 100 per cent stand	Computed yield per hectare	
			Days	*Kilos*		*Kilos*	*Cavans*
	Check I (Inantipolo)	94	128	14.30	15.21	....	....
1335	Quinirispinong Puti	95	133	8.96	9.43	841.11	19.29
1324	Kinacao	96	133	9.30	9.68	906.67	20.80
613	Mayoro I	97	133	8.40	8.66	831.11	19.06
644	Nagsayang Pula	92	128	11.82	12.85	1,334.44	30.61
1331	Mita	98	128	6.86	7.00	722.22	16.56
1226	Mangasa I	91	132	.90	.99	92.22	2.11
	Guininto	96	128	6.80	7.08	806.66	18.50
	Sanglay	88	139	2.16	2.45	330.00	7.57
362	Dinagat I	94	139	3.02	3.21	452.22	10.37
	Agri-Luya	89	129	7.82	8.78	1,108.89	25.43
1317	Dinolores	92	129	6.54	7.11	961.11	22.04
	Macan-Aga	96	(a)	....	....	....	....
	Check II (Inantipolo)	96	128	10.34	10.77	....	....

[a] Immatured.

TABLE V.—*Variety test of upland rice at the Lamao Experiment Station for the year 1924*—Continued

Permanent number	Variety name	Percent age of stand	Age at maturity	Actual yield	Corrected yield at 100 per cent stand	Computed yield per hectare	
			Days	*Kilos*		*Kilos*	*Cavans*
673	Pileng Baybay	94	131	4.32	4.60	677.78	15.55
	Pinursigue	5	134	.03	.60	196.67	4.51
	Kinamalig	92	129	7.38	8.02	984.44	22.58
	Binohañgin	84	141	1.48	1.78	287.78	6.60
966	Daliket	92	125	.63	.68	95.56	2.19
1336	Sinadyaya	97	128	.58	.60	50.00	1.15
	Macan Kumpol	90	(a)	......	......	......	......
998	Macarañag II	85	129	6.66	7.83	780.00	17.94
	Buric ni Martin	91	(a)	......	......	......	......
	Vinirgin	96	129	6.52	6.80	592.22	13.58
	Check III (Inantipolo)	92	128	13.28	14.43	......	......
	Check IV (Inantipolo)	94	128	10.48	11.14	......	......
	Dinalaga	98	128	10.04	10.24	1,145.56	26.27
	Dinulis	96	133	14.78	15.32	1,708.89	39.19
937	Binicol II	95	128	13.68	14.40	1,605.56	36.84
1323	Inacopanga	92	128	9.28	10.08	1,124.44	25.79
	Inusin	95	128	11.04	11.62	1,294.44	29.69
1048	Inintiw	94	133	2.30	2.44	273.33	6.27
1050	Kinastila V	90	135	13.20	14.66	1,630.00	37.36
	Delitus	80	129	3.52	4.40	488.89	11.21
	Pauni	97	136	9.72	10.02	1,112.22	25.51
	Macaneng	86	(a)	......	......	......	......
	Macan Pulo	92	140	2.60	2.82	310.00	7.11
620	Minantica I	93	135	3.64	3.91	430.00	9.86
	Check V (Inantipolo)	96	128	10.85	11.30	......	......
	Inabaca	92	138	1.70	1.84	335.56	7.69
1110	Mangasa II	96	129	6.12	6.37	805.56	18.47
120	Binulagsak or Bulagsac	94	129	8.06	8.57	1,016.67	23.32
	Buric	88	129	5.58	6.34	757.78	17.38
	Minantica II	92	129	5.94	6.45	714.44	16.63
	Mangasa III	94	140	6.90	7.34	780.00	17.89
	Mimis	92	(a)	......	......	......	......
	Kinawayan	90	143	2.42	2.68	162.22	3.72
	Check VI (Inantipolo)	94	129	13.48	14.25	......	......
	Check VII (Inantipolo)	90	129	14.10	15.66	......	......
1326	Kinanda	90	131	3.62	4.02	88.89	2.04
	Tapuy	88	136	2.60	2.95	10.00	0.23
	Nagkayat	82	130	2.92	3.56	117.78	2.70
956	Inantipolo II	84	129	10.20	12.14	1,151.11	26.49
990	Kaawa	92	130	3.55	3.85	270.00	6.10
	Inangel	96	130	4.05	4.21	350.00	8.03
	Buliro	90	130	1.25	1.38	75.56	1.73
1138	Sinampaga	86	130	1.65	1.92	175.56	4.03
	Quinate	88	130	1.95	2.21	247.78	5.68
	Dumali	84	116	1.35	1.60	220.00	5.04
	Malagkit Macapilay Pusa	92	136	0.87	0.94	186.67	4.28
	Buluhan	94	140	1.17	1.24	260.00	5.96
1364	Binagontauo	84	130	4.96	5.90	817.78	18.75
	Pirurutong	92	130	4.16	4.52	704.44	16.15
	Tintanos	97	130	5.20	5.36	837.78	19.21
1216	Kinandang Pula	96	137	2.48	2.58	568.89	13.05
	Tangi Sinampay Bacod	90	138	1.38	1.53	492.22	11.29
	Malagkit	87	142	1.10	1.26	502.22	11.52
	Check VIII (Inantipolo)	96	129	8.20	8.43	......	......

[a] Immatured.

Excellent crops would have been obtained from this culture if they had not been injured by typhoons and attacks by "atangia," which made chaff of the heads. Those varieties that headed earlier and later as indicated in the table of production suffered the most. The grains of the early maturing varieties were eaten by "mayang pula." Five varieties, namely, the Macan-Aga, Buric ni Martín, Macan Kumpol, Macaneng and Mimis seemed to be lowland palay. Because of their late maturing characteristics, it was decided to omit them in the following

year's culture. This was the first test of the sixty-two varieties represented in the collections of upland rice at the Lamao Experiment Station.

From the results obtained as shown in Table VI the varieties which came out the best in the test were the Dinulis, Kinastila V, Binicol II, Nagsayang Pula, Inusin, Inantipolo II, Dinalaga, Inacopañga, Pauni, Agri-Luya, Binulagsak, Kinamalig, Dinolores and Kinacao in the order of their enumeration. The yield was from 20.8 to 39.2 cavans or 906.88 to 1,709.12 kilos per hectare.

Head-to-the-row test.—The object was to isolate the most productive strains responsible for the high yielding capacity of the crop and at the same time to establish pure line strains of the variety tested.

1. Number of varieties under test.... One (Kinastila)
2. Area of field used.... 424 square meters
3. Area occupied by each head.... 4 square meters
4. Number of check plots.... 6
5. Previous crops.... Newly opened field
6. Date of planting.... June 27, 1924
7. Method of planting.... By using string in lining and markers made for the purpose. The marker was used to make the holes and 3 to 5 seeds were dropped into each hole.
8. Spacing.... 20 by 20 centimeters
9. Date of germination.... June 30, 1924
10. Frequency of cultivation.... Only once
11. Method of cultivation.... Thinning and weeding
12. Date of harvesting.... November 15, 1924
13. Actual expenses per plot.... ₱0.14
14. See Table VI for results.

TABLE VI.—*Head-to-the-row test of Kinastila rice at the Lamao Experiment Station for the year 1924*

Row number	Percentage of stand	Average number of culms per stool	Actual yield	Corrected yield at 100 per cent stand	Computed yield per hectare	
			Kilos		*Kilos*	*Cavans*
Check I	92	3	.240	.261	....	....
1	68	4	.390	.574	1,562.5	33.54
2	24	4	.189	.788	2,085.0	47.82
3	53	4	.402	.759	2,000.0	45.87
4	50	3	.278	.556	1,480.0	33.94
5	50	3	.380	.840	2,177.5	49.94
6	60	3	.434	.723	1,872.5	42.95
7	95	3	.608	.640	1,652.5	37.90
8	86	3	.454	.528	1,360.0	31.92
9	91	3	.602	.662	1,682.5	38.59
10	38	4	.223	.587	1,482.5	34.00

TABLE VI.—*Head-to-the-row test of Kinastila rice at the Lamao Experiment Station for the year 1924*—Continued

Row number	Percentage of stand	Average number of culms per stool	Actual yield	Corrected yield at 100 per cent stand	Computed yield per hectare	
			Kilos		*Kilos*	*Cavans*
11	22	4	.195	.886	2,217.5	50.86
12	66	4	.469	.711	1,767.5	40.54
13	72	3	.410	.569	1,400.0	32.11
14	88	3	.433	.494	1,200.0	27.52
15	87	3	.477	.548	1,322.5	30.33
16	91	3	.487	.535	1,252.5	28.72
17	75	3	.355	.473	1,110.0	24.46
18	73	2	.229	.314	700.0	16.06
19	67	3	.262	.391	880.0	20.18
20	64	4	.335	.523	1,197.5	27.47
Check II	82	2	.306	.373	....	......
21	63	3	.378	.600	1,587.5	36.41
22	79	4	.465	.590	1,555.0	35.67
23	82	3	.397	.484	1,257.5	28.84
24	69	3	.168	.244	675.0	15.48
25	26	4	.203	.781	2,010.0	46.10
26	52	2	.275	.529	1,372.5	31.48
27	50	3	.381	.762	1,947.5	44.67
28	85	3	.236	.278	730.0	16.74
29	63	3	.314	.499	780.0	17.89
30	77	3	.294	.382	975.0	22.36
31	73	2	.203	.278	707.5	16.23
32	64	2	.365	.570	1,430.0	32.79
33	84	3	.440	.524	1,307.5	29.98
34	90	2	.318	.353	872.5	20.01
35	77	3	.416	.540	1,332.5	30.56
36	70	2	.259	.370	900.0	20.64
37	78	3	.395	.506	1,232.5	28.26
38	71	3	.305	.430	1,035.0	23.74
39	69	3	.322	.467	1,120.0	25.68
40	78	3	.329	.422	1,000.0	22.93
Check III	86	3	.386	.449	....	......
41	47	3	.245	.521	1,140.0	26.15
42	63	3	.427	.678	1,550.0	35.56
43	82	2	.352	.429	945.0	21.67
44	77	3	.395	.513	1,172.5	26.88
45	70	2	.262	.374	842.5	19.31
46	82	3	.424	.517	1,217.5	27.92
47	79	2	.325	.411	970.0	22.25
48	86	2	.284	.330	785.0	18.69
49	89	2	.531	.597	1,470.0	33.71
50	67	2	.191	.285	707.5	16.23
51	78	2	.301	.386	977.5	22.42
52	77	2	.255	.292	760.0	17.43
53	67	2	.303	.452	1,175.0	26.95
54	77	2	.332	.431	1,142.5	26.20
55	71	3	.323	.455	1,220.0	28.00
56	81	2	.265	.327	917.5	21.04
57	81	2	.304	.375	1,055.0	24.20
58	92	2	.435	.473	1,317.5	30.22
59	46	3	.251	.546	1,517.5	34.79
60	39	2	.186	.477	1,362.5	31.25
Check IV	74	2	.222	.300	....	......
61	69	2	.246	.357	842.5	19.32
62	55	3	.159	.289	677.5	15.54
63	70	3	.244	.349	832.5	19.09
64	91	2	.391	.430	1,040.0	23.62
65	94	2	.374	.398	965.0	22.13
66	95	2	.253	.266	640.0	26.17
67	69	2	.211	.306	745.0	17.09
68	89	2	.195	.220	535.0	12.27
69	79	2	.256	.324	800.0	18.35
70	70	2	.294	.420	1,055.0	24.20
71	84	3	.294	.350	885.0	20.30
72	78	3	.243	.312	795.0	18.23
73	77	2	.239	.310	795.0	18.23
74	82	3	.233	.284	735.0	16.86
75	80	2	.254	.317	822.5	18.85
76	62	2	.203	.327	852.5	19.54
77	52	3	.226	.435	1,122.5	25.73
78	50	3	.240	.480	1,245.0	28.55
79	58	3	.183	.316	840.0	19.27
80	72	2	.185	.257	697.5	16.00

TABLE VI.—*Head-to-the-row test of Kinastila rice at the Lamao Experiment Station for the year 1924*—Continued

Row number	Percentage of stand	Average number of culms per stool	Actual yield	Corrected yield at 100 per cent stand	Computed yield per hectare	
			Kilos		*Kilos*	*Cavans*
Check V	84	2	.214	.255	....	....
81	72	2	.173	.240	822.5	18.85
82	77	2	.249	.323	1,012.5	23.21
83	64	2	.248	.388	1,152.5	26.43
84	73	3	.238	.326	975.0	22.36
85	77	2	.273	.355	1,025.0	23.51
86	61	2	.272	.446	1,480.0	33.94
87	63	2	.257	.408	1,112.5	25.51
88	65	3	.251	.386	1,035.0	23.74
89	67	2	.203	.303	805.0	18.46
90	60	2	.224	.373	957.5	23.10
91	71	3	.256	.361	905.0	20.75
92	49	3	.154	.315	767.5	17.60
93	48	3	.180	.375	895.0	20.53
94	74	2	.253	.342	790.0	18.12
95	63	3	.218	.346	777.5	17.82
96	81	3	.449	.554	1,225.0	28.10
97	76	2	.361	.475	1,055.0	24.19
98	62	3	.419	.676	1,535.0	35.21
99	78	2	.324	.415	860.0	19.72
100	52	2	.454	.873	1,982.5	45.46
Check VI	87	2	.396	.455	....	....

NOTE.—1 cavan=43.6 kilos. Average yield of all checks=0.349 kilo or 877.5 kilos to the hectare or 20.01 cavans.

Plants from selected seeds gave as high as 50.86 cavans or 2,217.50 kilos per hectare, as was the case with plant No. 11, whereas the average yield of the check variety where no selection was done was only 20.01 cavans or 872.43 kilos. Higher yields were also correlated with those plants having more culms per stool. As to the average number of culms per stool, the nonselected had in most cases less culms than the selected plants.

Seeding per hill.—The object was to determine the proper number of seeds to be planted in each hill that a high yield might be obtained.

1. Number of varieties tested............ One (Inantipolo)
2. Area of field occupied..................... 236 square meters
3. Area for each test............................ 20 square meters
4. Previous crops .... Newly opened field
5. Date of transplanting...................... August 12, 15 and 16, 1924, but the seedlings used were planted June 22, 1924
6. Method of transplanting................ The seedlings used in this test were taken from the propagation plot of Inantipolo. The top parts of the plants were cut off before transplanting. The holes were made with a marker and a trowel.

7. Spacing .... 20 by 20 centimeters.
8. Date of initial growth...................... August 19–21, 1924
9. Frequency of cultivation.............. Only once
10. Method of cultivation........................ Only weeding
11. Date of harvesting.............................. November 14, 1924
12. See Table VII for results.

TABLE VII.—*Seeding experiment at the Lamao Experiment Station for the year 1924*

Number of seed planted per hill	Seeding			Percentage of stand	Average number of culms per stool	Actual yield of grains	Corrected yield at 100 per cent stand	Computed yield per hectare
	Actual	Per hectare	Cost per hectare					
	Kilos	*Kilos*	*Pesos*			*Kilos*		*Kilos*
1	0.0125	6.25	0.57	94	4.0	0.82	0.87	435
2	0.0250	12.50	1.14	92	3.3	1.08	1.15	575
3	0.0375	18.75	1.71	96	3.7	1.20	1.25	625
4	0.0500	25.00	2.28	95	4.4	0.98	1.03	515
5	0.0625	31.25	2.85	93	5.9	1.24	1.33	665
6	0.0750	37.50	3.42	90	6.2	1.16	1.29	645
7	0.0875	43.75	3.99	97	7.2	0.96	0.99	495
8	0.1000	50.00	4.56	96	8.0	0.86	0.90	450
9	0.1125	56.25	5.13	93	9.0	0.78	0.82	410
10	0.1250	62.50	5.70	97	10.0	0.49	0.51	255

NOTE.—Cost per cavan of seed, ₱4.

Seeds should have been used in the test rather than seedlings in order to find out the real behavior of upland rice when few or many seeds were planted in each hill, but because of the lateness of the season seedlings from the propagation plot of Inantipolo palay had to be transplanted to carry out the test. Though seedlings were used the results obtained give an idea as to how many seeds should be dropped to the hill in planting upland rice. Planting a few seeds promoted the development of more culms per stool, whereas with many seeds there was no increase at all. Planting one and two seeds to the hill gave the highest average of culms per stool, but in grain production 5, 3, and 6 seeds per hill yielded the best. Judging from the above figures not more than six seeds to the hill of upland rice should be planted. Any more will only be a waste of seeds and cause a lower yield. The culture was attacked by "atañgia," the heads became chaffy and the yield was consequently low.

Depth of planting.—Mayoro rice was used in the test. The results as tabulated below indicate that rice seeds should not be covered with soil to more than three centimeters deep. One centimeter is found to be the best depth. Besides, if planted 7 or 8 centimeters deep germination took place 10 to 11 days late.

TABLE VIII.—*Depth of planting experiment at the Lamao Experiment Station for the year 1924*

Depth (cm.)	Number of seeds planted	Date of—		Number of seeds germinated	Per cent of germination
		Planting	Germination		
1	6	3-14-24	3-19-24	6	100
2	6	3-14-24	3-19-24	4	66.67
3	6	3-14-24	3-20-24	5	83.33
4	6	3-14-24	3-21-24	2	33.33
5	6	3-14-24	3-21-24	2	33.33
6	6	3-14-24	3-21-24	1	16.67
7	6	3-14-24	3-31-24	2	33.33
8	6	3-14-24	4- 1-24	1	16.67
9	6	3-14-24	[a]	[a]	[a]
10	6	3-14-24	[a]	[a]	[a]
11	6	3-14-24	[a]	[a]	[a]

[a] Unable to reach the surface of the ground.

Seasonal planting.—Seeds of the Mayoro palay were used in this test. Planting was done monthly. The plantings from January to April gave no harvest. Crops were harvested only from the May planting. No planting was done in June because of the impossibility of preparing the too wet ground during that month. Seeds planted during the months of August to December failed to germinate, and there were no fresh seeds to be tested.

Longevity test.—Mayoro seed palay was preserved under two conditions; namely, in cloth bags and air-tight containers. Initial germination tests were made every month by planting 50 seeds in each test plot until the seeds had lost their entire viability. Table IX below gives the results of this experiment.

TABLE IX.—*Viability test of Mayoro Rice at the Lamao Experiment Station for the year 1924*

Date of—		Number of seeds tested	Control		Cloth bag		Air-tight container	
Planting	Germination		Number of seeds germinated	Percentage germination	Number of seeds germinated	Percentage germination	Number of seeds germinated	Percentage germination
2- 2-24	2-26-24	50	50	100	48	96	50	100
3-21-24	3-26-24	50	36	72	45	90	35	70
4-25-24	4-30-24	50	21	42	15	30	20	40
5-25-24	5-30-24	50	20	40	12	24	21	42
6-25-24	6-30-24	50	14	28	14	28	16	32
7-25-24	7-30-24	50	9	18	0	0	10	20
8- 8-24	8-14-24	50	1	2	26	52	7	14
9- 2-24	9- 8-24	50	1	2	22	44	7	14
10-15-24	10-22-24	50	[a]	0	20	40	10	20
11-13-24	....	50	[a]	0	[a]	0	[a]	0
12- 6-24	....	50	[a]	0	[a]	0	[a]	0

[a] None.

The viability of good rice seed may be retained by keeping it either in cloth bags or sacks or in air-tight containers for at

least nine months, while its germinative power decreases as it becomes old.

1925

General variety test.—Of the 66 varieties tried the Kinastila, Mayoro, Dinulis, Inantipolo, Binicol, Minantica II, Tapacoy, Tapuy, Buric and Macarañag gave the highest yields, from 14.25 to 24.10 cavans or from 621.3 to 1,050.76 kilos per hectare, while the other varieties yielded only from none to 14.14 cavans or 616.5 kilos. Eighty-one pesos and sixty-seven centavos (₱81.67) was the computed cost per hectare. A special variety test of Kinastila, Inantipolo, Dinulis and Binicol was also conducted during the year. The Kinastila and Inantipolo gave yields of 471.35 and 355.21 kilograms per hectare, respectively—the highest. The computed expenditure was ₱65.43 per hectare. Poor yields were obtained from these tests because of pests and diseases.

In the head-to-the-row test of Kinastila the highest yields were from 1,365 to 1,952 kilograms per hectare which is equivalent to 31.37 and 44.77 cavans. High yields were found to be correlated with the highest average of culms per stool and grains per head, and also with the length of the panicles.

The seeding experiment indicated that planting too many seeds to the hill gave no appreciable increase in the production of upland palay. Three to four seeds in each hill gave the highest yield. An increase of about 150 per cent was recorded in this experiment.

Kinastila seeds were planted at depths of 1 to 11 centimeters in seed flats. Seeds planted at from 1 to 5 centimeters deep gave from 80 to 100 per cent germination while seeds planted at from 6 to 11 centimeters deep could hardly reach the surface of the ground and gave only from 35 to 75 per cent germination.

The results obtained from the seasonal planting test indicated that the best time to plant upland rice was from May to August in the locality of Lamao. Plantings made after or before these months did not produce any yields unless irrigated.

Seed palay stored in cloth bags, paper bags, bottles and in bottles mixed with either ashes or soil were still viable at the end of eleven months. The two first named kinds of containers however, gave the highest percentage of germination—40 and 64 per cent.

1926

General variety test.—In spite of the attacks of worms during the early stages of the plants, good results were obtained from

the test, which embraced 63 varieties. Worms ate the plants in many cases down close to the ground thus causing low stands. The culture was rather weedy, for the low stands of the plants gave the weeds room to multiply. Efforts to combat the attacks of worms were of no avail because they were too numerous. Of the 63 varietes tested, the Mayoro, Sinampiro, Kinastila, Panay, Inantipolo, Binicol, Linuguan, Kinamalig, Sinampay Bakod, Pileng Baybay, Kinacao, Puti and Kinastaño gave the highest yields, which varied from 33.12 to 40.59 cavans or 1,444.03 to 1,769.72 kilos to the hectare. The other varieties yielded only from 4.11 to 29.08 cavans or from 179.20 to 1,267.88 kilos. The low yields of other varieties were due to their early maturing and the attacks of "atangia" and "maya." The computed cost of production was ₱84 per hectare.

A special variety test of the best varieties resulting from the general variety test of the preceding year was also conducted, but the culture was so badly attacked by worms that there was no harvest. Some results were obtained from the crop rotation test planted to Binicol. The land was plowed when the plants were seen to be past recovery.

In the head-to-the-row test of Kinastila the low yield was attributed to the attacks of worms. The highest yields were from 1,238 to 1,760 kilos per hectare, which is equivalent to 28.39 and 40.59 cavans. High yields were found to be correlated with the highest average number of culms per stool and grains per head, and also with the length of the panicles.

The seeding experiments showed that planting too many seeds to the hill gave no appreciable increase in the production of upland palay. Planting 3 to 4 seeds to each hill gave a good development of the plants with stout culms and long panicles, thus giving a high yield of grain. Dropping too many seeds is a mere waste of seed materials and the plants produced are slender and weak, hardly able to produce panicles. In this test 2,465.76 kilos was obtained per hectare by dropping three seeds only to each hill, and 2,183.74 kilos, with four seeds to each hill. Lower and lower yields were obtained as the number of seeds dropped were increased.

Planting upland rice deeper than 3 centimeters resulted in low percentage and delayed dates of germination, and in attacks by ants and other pests.

Monthly seasonal plantings were also conducted in order to find out in what months upland rice could be planted with a promise of good harvest. Plantings made during May and

June gave good results. Other plantings made during the year gave very poor results, especially those of January, February, March, and April. To keep the selected seeds viable until the next planting season is of vital importance to the farmers. In the tests made, properly dried seeds kept in cloth bags, paper bags and air-tight containers up to the eleventh month, gave 60, 54, and 50 per cent germination, respectively. When other methods were employed the viability of the seed was soon lost.

1927

General variety test.—A newly opened field was used for carrying out the variety test of upland rice, which took in 93 varieties. The rice was planted on June 22 and 23, 1927, a time too late for planting upland rice because of the lack of laborers for preparing the land. However, very good crops were obtained. Of those tested, the Kinastila, Dinolores, Mocal, Inangel, Sinampiro, Kabuyok, Quinamantigue, Agri-Luya, Dinalaga and Pileng Baybay gave the highest yields, which varied from 50 to 63.13 cavans to the hectare. The other varieties yielded only from 4.39 to 49.43 cavans. The early maturing and aromatic varieties gave very low or no yields at all because they were very susceptible to the attacks of rats, bats, "maya," "atangia," etc. The Bhuang Ngern, Kao Chao Hom and Caviteña were found to be lowland varieties. The Nagako Shrinriki, K. A. C. No. 109 and K. A. C. No. 722 did not germinate at all. Considering all the expense involved in carrying out the test, the cost of production totaled ₱123.68 per hectare.

Of the special variety test of upland rice which covered four varieties, the Kinastila again led, with a yield of 58.31 cavans to the hectare, followed by Dinolores with a yield of 48.51 cavans at a cost of production of ₱86.74.

The seeds harvested from the five highest yielding rows in the head-to-the-row test of Kinastila the preceding year were planted in five different plots of equal area to test further which would give the highest yield and to multiply the strains; but the cultures did not produce any grain because of the pests that attacked the plants during the heading stage. Efforts were made to save the strains, but were futile.

To verify the results so far obtained from our seeding experiment on upland rice and to make it conclusive, a culture for this test was carried out. Favorable results were obtained from the planting of 3 and 4 seeds to the hill, with a yield of 2,566.67 and 2,300 kilos to the hectare, respectively. The plants produced

from placing 6, 7, 8, 9 and 10 seeds to the hill were slender, developed no culms and produced poor short panicles. The plants resulting from sowing one and two seeds to the hill were vigorous, producing plenty of culms with long heavy panicles. The 3- and 4-seed method proved the better of the two.

TABLE X.—*Summary of variety tests of upland rice at the Lamao Experiment Station for the period 1921–24*

Number	Variety name	Yield per hectare in kilos				
		1921	1922	1923 [a]	1924	Average yield per hectare
777	Sagoboy	1,300	276	....	....	788.00
1320	Guinamat	760	232	....	....	496.00
1226	Mangasa I	....	96	....	92.22	94.11
1110	Mangasa II	1,100	....	....	805.56	952.78
	Mangasa III	....	....	....	780.00	780.00
1485	White Mangasa	760	502	....	....	631.00
1324	Kinacao	1,100	454	....	906.62	1,230.33
1342	Ngapol	1,120	184	....	....	652.00
1327	Kinilay	1,020	444	....	....	732.00
1329	Malagoso	900	....	....	....	900.00
260	Caporcas I	920	128	....	....	524.00
1334	Pilit Morado	1,040	540	....	....	790.00
1318	Galong Famy	560	....	....	....	560.00
1314	Cuoab	680	238	....	....	459.00
1048	Inintiw	800	444	....	273.33	505.77
1049	Macan II	580	....	....	....	580.00
1244	Cainti	680	....	....	....	680.00
1319	Galong Santa Maria	1,000	....	....	....	1,000.00
1326	Kinanda	1,320	196	....	....	758.00
644	Nagsayang pula	1,500	728	....	1,334.44	1,187.48
966	Daliket	1,060	....	....	95.56	577.78
520	Lubang pula	1,160	356	....	....	758.00
1332	Naglantik	1,160	584	....	....	872.00
1103	Lubang blanco	1,280	636	....	....	958.00
1139	San Fabian	1,180	408	....	....	794.00
282	Caririt	700	456	....	....	578.00
1302	Binagacay	560	428	....	....	494.00
1216	Kinandang pula	740	256	....	568.89	521.63
205	Colapdos	640	596	....	....	618.00
262	Capotol	2,020	1,000	....	....	1,510.00
1311	Carabao	180	....	....	....	180.00
448	Inaslom	1,040	....	....	....	1,040.00
613	Mayoro I	1,040	186	....	831.11	685.70
1181	Pol-lique	1,700	....	....	....	1,700.00
1237	Binalintin	580	....	....	....	580.00
1321	Guinan	580	668	....	....	624.00
1284	Guinaboc	1,520	514	....	....	1,017.00
1312	Capayong	940	....	....	....	940.00
120	Bulagsac or Binulagsac	760	....	....	1,016.67	888.33
	Bulao	1,368	....	....	....	1,368.00
1304	Binongang Loay	1,360	922	....	....	1,141.00
1361	Binoguinguin	1,020	648	....	....	834.00
620	Minantica I	640	....	....	430.00	535.00
	Minantica II	....	....	....	714.44	714.44
572	Malido	680	764	....	....	722.00
1339	Tonguitan	1,380	228	....	....	804.00
1489	Inantak	1,160	596	....	....	878.00
1299	Bayangbang	1,740	446	....	....	1,093.00
1279	Bandera	800	....	....	....	800.00
229	Calonod	540	386	....	....	463.00
1335	Quinirispinong Puti	1,020	510	....	841.11	790.37
1313	Carawin	2,020	650	....	....	1,335.00
1308	Caluis	560	....	....	....	560.00
980	Kinastila IV	920	....	....	....	920.00
1050	Kinastila V	....	408	....	1,630.00	1,019.00
1193	Kinastila VII	....	86	....	....	86.00
1309	Caña Bombo	1,600	446	....	....	1,023.00
338	Dali	880	....	....	....	880.00
1341	Buaoa	1,000	298	....	....	649.00
78	Binagontauo	1,000	....	....	....	1,000.00
1364	Binagontauo	....	608	....	817.78	712.89

[a] Mature plants carried away by flood.

TABLE X.—*Summary of variety tests of upland rice at the Lamao Experiment Station for the period 1921–24*—Continued

Number	Variety name	Yield per hectare in kilos				
		1921	1922	1923 [a]	1924	Average yield per hectare
1330	Layag	960	150	...	...	555.00
347	Dap-pog	580	...	...	...	580.00
67	Binabaye II	1,040	538	...	...	789.00
1383	Menita	940	314	...	...	627.00
346	Kinalangkang	740	...	...	...	740.00
1343	Quinokong uwak	1,160	56	...	...	608.00
1340	Unoy Dagoydoy	860	232	...	...	546.00
1317	Dinolores	780	182	...	961.11	641.03
1097	Initlog-dalag	420	...	...	...	420.00
	Piniling Malatiit	580	...	...	...	580.00
1332	Guimat	1,220	130	...	...	675.00
1004	Roxas	1,240	...	...	...	1,240.00
956	Inantipolo II	680	274	...	1,151.11	701.70
1217	Kinandang puti	640	252	...	...	446.00
1333	Luyot	900	144	...	...	522.00
958	Macatibos I	1,040	404	...	...	722.00
	Cabijud	640	...	...	...	640.00
1353	Aikoku	1,580	558	...	...	1,069.00
306	Catorsa	560	232	...	...	396.00
987	Magdalena	...	460	...	...	460.00
1213	Inagsaya	...	218	...	...	218.00
639	Nagdami	...	368	...	...	368.00
1331	Mita	...	...	...	722.22	722.22
1298	Ban-ar	...	270	...	...	270.00
1188	Sekitori	...	...	...	...	...
1249	Nagrion	...	292	...	...	292.00
1166	Kinandang kumpol	...	116	...	...	116.00
1230	Naglihim	...	394	...	...	394.00
362	Dinagat I	...	...	...	452.22	452.22
619	Mantica Pilit	...	610	...	...	610.00
1252	Bangol	...	276	...	...	276.00
879	Tinomanan	...	...	...	...	...
1565	Quinamantigue	...	378	...	...	378.00
1315	Danilog	...	204	...	...	204.00
515	Lubang II	...	340	...	...	340.00
1305	Cabayo	...	560	...	...	560.00
1500	Macapno	...	302	...	...	302.00
47	Barangcal	...	342	...	...	342.00
1338	Tapacoy	...	450	...	...	450.00
1351	Oyoy	...	270	...	...	270.00
1348	Cadidi	...	224	...	...	224.00
1001	Apostol	...	456	...	...	456.00
1147	Cutsiam II	...	230	...	...	230.00
999	Hinirang	...	642	...	...	642.00
1100	Lampadan or Allangigan	...	832	...	...	832.00
1490	Sinaria	...	676	...	...	676.00
951	Kalibod	...	328	...	...	328.00
126	Bulandi	...	480	...	...	480.00
1285	Kinampupoy	...	386	...	...	386.00
1250	Thul Chalong	...	376	...	...	376.00
1325	Kinayabog	...	416	...	...	416 00
774	Sacsek	...	856	...	...	856.00
	Check	...	514	...	...	514.00
1347	Caviteña a Biit	...	304	...	...	304.00
1146	Casulig	...	234	...	...	234.00
1148	Tuhao III or Caot	...	282	...	...	282.00
943	Bonguet	...	164	...	...	164.00
991	Malagkit-Kaawa	...	244	...	...	244.00
1564	Malagkit	...	...	...	502.22	502.22
1133	Samban	...	152	...	...	152.00
1386	Panay	...	234	...	...	234.00
1149	Bagsang	...	192	...	...	192.00
1125	Pinili a Biit	520	414	...	...	467.00
574	Maliro	...	548	...	...	548.00
1316	Dayome	...	470	...	...	470.00
1231	Nagoyon	...	648	...	...	648.00
254	Capichola	...	358	...	...	358.00
1073	Calibog	...	420	...	...	420.00
1323	Inacopanga	...	280	...	1,124.44	702.22
990	Kaawa	...	526	...	270	398.00
1328	Check	...	588	...	...	588.00
530	Macan Piña	...	244	...	...	244.00

[a] Mature plants carried away by flood.

TABLE X.—*Summary of variety tests of upland rice at the Lamao Experiment Station for the period 1921–24*—Continued

Number	Variety name	Yield per hectare in kilos				
		1921	1922	1923[a]	1924	Average yield per hectare
92	Binicol I		170			170.00
937	Binicol II	1,260	248		1,605.56	1,037.85
1289	Amariles		252			252.00
1337	Sarocot		186			186.00
1301	Bihoralog pula		108			108.00
998	Macarañag II		192		780.00	486.00
1561	Lintang anod		104			104.00
1300	Berilhon		476			476.00
979	Nagpunit		602			602.00
1387	Pinalengke		390			390.00
1234	Piniling Bebay		356			356.00
673	Piling Baybay		226		677.78	451.89
1136	Sinaba III		312			312.00
1101	Langauisan		362			362.00
1310	Caponguit		570			570.00
1138	Sinampaga		764		175.56	469.78
1320	Check		448			448.00
971	Kinastaño II		664			664.00
969	Binucawe		192			192.00
967	Binondoc II		230			230.00
724	Putyucanon		228			228.00
New	Guinolong		154			154.00
New	Pinursigue		758		196.67	477.33
1294	Gopher		524			524.00
1295	Storm Proof		722			722.00
New	Sinantamaria		286			286.00
	Guininto				806.66	806.66
	Sanglay				330.00	330.00
	Agri-Luya				1,108.89	1,108.89
	Kinamalig				984.44	984.44
	Binohangin				287.78	287.78
	Sinadyaya				50.00	50.00
	Vinirgin				592.22	592.22
	Dinalaga				1,145.56	1,145.56
	Dinulis				1,708.89	1,708.89
	Inusim				1,294.44	1,294.44
	Deiitos				488.89	488.89
	Pauni				1,112.22	1,122.22
	Macan pulo				310.00	310.00
	Inabaca				335.56	335.56
	Buric				757.78	757.78
	Buluhan				260.00	260.00
	Kìnawayan				162.22	162.22
	Tapuy				10.00	10.00
	Nagkayat				117.78	117.78
	Inangel				350.00	350.00
	Buliro				75.56	75.56
	Quinate				247.78	247.78
	Dumali				220.00	220.00
	Malagkit Macapilay Pusa				186.67	186.67
	Pirurutong				704.44	704.44
	Tintanos				837.78	837.78
	Tangi Sinampay Bacod				492.22	492.22

[a] Mature plants carried away by flood.

PARA RUBBER IN MINDORO

By F. G. Galang
Horticulturist

With the appropriation of ₱65,000 made available by Act No. 3230 during the latter part of 1925, the Bureau of Agriculture was able to conduct various tapping experiments on the Para rubber trees at the Halcon Rubber Plantation, Baco, Mindoro, beginning May 25, 1926. This plantation can be reached in about two or three hours by banca from Baruyan, Calapan, Mindoro.

OBJECTS

The main aim of the experiments was to find out the yield of Para rubber trees in the typhoon belt with a well-distributed rainfall throughout the year under the following conditions:

1. Tapping intervals
2. Comparison of the different methods of tapping
3. Comparative production of tapping once and twice a day
4. Thickness of bark shavings
5. Tapping angles
6. Tapping heights
7. Comparative cost of tapping Para rubber on level and hilly land
8. Fertilizer test
9. Selection work

CLIMATE AND SOIL

The western part of Mindoro usually has two very pronounced seasons: dry in winter and spring, wet in summer and autumn, while the eastern side has no pronounced maximum rainy period and no dry season. The Halcon Rubber Plantation, where the experiments are being undertaken is located in the northeastern part of Mindoro and this portion of the island has a rainfall of uniform distribution throughout the year, the rain falling mostly in the afternoon and evening, which is very favorable to the growing of Para rubber tree. Mindoro as a whole is within the typhoon belt, but the plantation is semi-protected from the strong winds on the eastern and southern parts by Mount Halcon and a low hill surrounds part of the area cultivated to rubber, except in the northern part toward Sabaang Bay.

The land occupied by the Para rubber trees is partly a steep hill and partly a level plain. The soil in general is rather deep

and of medium clay on the level plain and clay loam on the hilly portion. The level plain near the barrio of Lumang-Bayan is poorly drained, and it is believed that this condition is partly responsible for the poor development of the trees in that section of the plantation. The results of the chemical and mechanical analyses made by the Bureau of Science of the soil samples submitted by the Bureau of Agriculture are given below:

CHEMICAL ANALYSIS OF SURFACE SOIL

(Water-free basis)

	Per cent
Loss on ignition	6.768
Nitrogen (N_2)	1.652
Phosphoric anhydride (P_2O_5)	0.595
Lime (CaO)	1.131
Potash (K_2O)	1.315
Humus	0.852
Soil acidity (per cent $CaCO_3$)	0.678

MECHANICAL ANALYSIS

	Surface soil Per cent	Subsoil Per cent
Detritus not passing 1 mm. sieve	4.3	4.5
1. Coarse sand 1–0.5 mm.	3.9	3.6
2. Medium sand 0.5–0.25 mm.	7.2	7.3
3. Fine sand 0.25–0.10 mm.	10.9	12.8
4. Very fine sand 0.10–0.05 mm.	27.9	26.8
5. Silt 0.05–0.005 mm.	39.5	37.7
6. Clay 0.003 mm.	10.6	11.8
Total from 1 to 6	100.00	100.0

MATERIALS USED

The Para rubber trees under experiment are said to have been planted sometime in 1913 or 1914, and not less than 10,000 seedlings were originally set out, according to information obtained from people in the locality. Out of this number about 4,000 had reached the tapping age when the plantation was abandoned years ago. As a result of this many of the trees were cut down by the natives in the vicinity while clearing a portion of the plantation for "caiñgin" planting.

There were more or less 1,000 Para rubber trees found living after the clearing of the plantation done by the Bureau of Agriculture in 1926, and these were scattered over about 4 or 5 hectares of land. There are no indications whatsoever on the surviving trees to show that previous tapping had been done on the plantation. At the start of the experiments, May 25, 1926, the girths of the rubber trees varied from 16 to 65 inches

measured three feet from the ground. The trees were practically all in excellent condition except those on the plain near the barrio of Lumang-Bayan, which portion of the plantation is poorly drained; and those along the trail, where trees had been badly hacked by the passers-by and the boys in obtaining rubber for balls. These injured trees have grown with knotted bark and are therefore difficult to tap.

Before the plantation was abandoned it is said that the trees were kept clean by constant weeding on which work a considerable sum was expended. Since May 25, 1926, when the Bureau of Agriculture's work began there, the trees have been cleaned of weeds around their trunks from time to time, and the weeds between the rows of trees cut down once in a while to facilitate the gathering of the fallen seeds as well as the tapping of the trees and the collection of the latex.

No serious pest has so far been found attacking the Para-rubber trees in Mindoro, and in general the trees look healthy. However, a few trees were found to be infected with canker, *Phytophthora faberi* and collar rot, *Ustulina zonata*, but neither disease is considered serious in the rubber-growing countries. The former occurs mostly on poorly drained soil, and during the dry period it disappears. The collar rot is only a result of neglect after pruning, or after a wind has broken off the branches, or when dead wood has been left lying about the plantation. Painting the stump left with lead acetate after removing the affected parts has been found very effective.

METHODS

The land where the trees are selected for experimental purposes is divided into blocks and sections to suit the experiments. The trees have been numbered, marked and opened for tapping; and cup holders, spouts and collecting cups provided for each of the trees under experiment.

The latex collected from each of the trees in a block after it has been measured and recorded is mixed together in one bucket. The collecting cups are then washed and hung on a pole near the tree to get dry for the following tapping. The wash water is also collected in a bucket separate from that for the pure latex. The latex and wash water from the different experimental blocks are coagulated in separate pans after they have been sieved twice—once through a netted wire and then through a cheese cloth— to remove the impurities, such as leaves, branches, scrap rubber, etc. A 20 per cent solution of acetic acid is used in coagulating the latex and the wash water. After the addition

of the necessary acid to the latex and wash water the mixture is stirred well with a small bamboo or wooden paddle in order to mix the acid properly with the latex or wash water as the case may be. Then it is poured into enameled pans and left to settle until the following day, when the coagulum is kneaded with a wooden implement to remove all the water possible. This is now replaced by a small hand rubber roller. After this process the coagulum, which is now in the form of a small sheet, is hung on a wooden rack outside in the sun for a few hours to let the water adhering to it drip off. It is then weighed as wet rubber. Afterwards the rubber sheet is dried inside of the smokehouse till its constant weight is attained, which is recorded as weight of dry rubber. Smoking is usually carried on from 2 p. m. to 9 a. m. every day for about ten consecutive days, especially during the rainy days. The rubber produced from the latex and wash water, and the tree scrap are separately weighed and recorded as No. 1, 2, and 3 rubber. The daily production for each of the experiments is obtained by getting the total weights of rubber No. 1, 2 and 3 produced from the latex, wash water and tree scrap for that day on each of the blocks and calculating accordingly as per the latex production of each of the conditions called for in the experiment.

To prevent the rapid oxidation of the latex, a general cleaning of the spouts and collecting cups is done occasionally.

RESULTS

The results presented consist of the data obtained from the following experiments:

1. Tapping intervals
2. The different methods of tapping
3. The comparative production of tapping once and twice a day
4. The tapping heights
5. The individual yield records of the trees

The data so far gathered from the other experiments are inconclusive.

The relative merits of the different tapping intervals cut half-spiral to the left from May 31, 1926, to August 31, 1927 are shown in Table I.

(*a*) A small hand rubber roller in operation at the Halcon Rubber Sub-station, Baco, Mindoro

(*b*) A wooden rack where rubber sheets are being dried for a few hours at the Halcon Rubber Sub-station, Baco, Mindoro

TABLE I.—*Tapping intervals*

Tapping intervals	May 31–June 30, 1926			July, 1926			August, 1926		
	Tapping days	Latex in liters	Dry rubber	Tapping days	Latex in liters	Dry rubber	Tapping days	Latex in liters	Dry rubber
			Kilos			*Kilos*			*Kilos*
Daily	26	22.860	10.904	27	21.089	10.460	27	33.389	12.955
Alternate daily	14	6.102	2.911	14	10.234	5.076	12	9.420	3.655
Every two days	...	...	...	...	...	...	...	...	...
Every three days	...	...	...	...	...	...	...	...	...
Every four days	...	...	...	...	...	...	...	...	...
Every five days	...	...	...	...	...	...	...	...	...
Every six days	...	...	...	...	...	...	...	...	...
Alternate weekly	13	5.976	2.851	15	8.077	4.006	15	6.808	2.642
Alternate bi-weekly	15	7.278	3.472	14	7.541	3.740	13	11.694	4.537
Alternate tri-weekly	17	5.728	2.732	18	2.962	1.469	18	2.020	0.784
Alternate monthly	26	13.974	6.666	...	...	...	28	18.971	7.361
Every six months	...	...	...	...	...	...	...	...	...
Total	111	61.918	29.536	88	49.903	24.751	113	82.302	31.934

Tapping intervals	September, 1926			October, 1926			November, 1926		
	Tapping days	Latex in liters	Dry rubber	Tapping days	Latex in liters	Dry rubber	Tapping days	Latex in liters	Dry rubber
			Kilos			*Kilos*			*Kilos*
Daily	25	30.685	10.402	26	28.669	10.206	20	22.399	8.332
Alternate daily	12	8.731	3.060	12	7.534	2.682	10	9.158	3.406
Every two days	...	...	...	...	...	...	9	5.872	2.184
Every three days	...	...	...	...	...	...	11	8.845	3.290
Every four days	...	...	...	...	...	...	11	8.896	3.309
Every five days	...	...	...	...	...	...	10	6.524	2.427
Every six days	...	...	...	...	...	...	9	3.972	1.478
Alternate weekly	12	6.887	2.335	13	5.061	1.802	13	8.036	2.979
Alternate bi-weekly	12	6.789	2.301	14	7.444	2.650	9	5.522	2.054
Alternate tri-weekly	11	3.072	1.041	18	5.429	1.933	11	2.497	0.929
Alternate monthly	...	...	...	27	19.461	6.928	...	...	...
Every six months	...	...	...	...	...	...	20	12.440	4.628
Total	72	56.164	19.139	110	73.598	26.201	133	94.161	35.016

Tapping intervals	December, 1926			January, 1927			February 1927		
	Tapping days	Latex in liters	Dry rubber	Tapping days	Latex in liters	Dry rubber	Tapping days	Latex in liters	Dry rubber
			Kilos			*Kilos*			*Kilos*
Daily	17	16.381	5.602	26	28.207	9.732	24	20.511	7.199
Alternate daily	7	4.919	1.682	12	9.776	3.373	11	4.718	1.656
Every two days	8	4.843	1.656	15	7.073	2.440	14	5.002	1.756
Every three days	9	5.410	1.850	13	7.426	2.562	9	4.093	1.437
Every four days	6	4.178	1.429	14	9.540	3.291	14	8.886	3.119
Every five days	9	4.688	1.603	15	9.161	3.161	12	8.493	2.981
Every six days	10	4.843	1.656	10	3.998	1.379	12	4.272	1.499
Alternate weekly	12	6.908	2.363	13	7.162	2.471	13	5.048	1.772
Alternate bi-weekly	9	6.051	2.069	11	7.720	2.663	12	5.962	2.093
Alternate tri-weekly	6	1.725	0.590	13	4.379	1.511	19	2.832	0.994
Alternate monthly	18	12.048	4.120	...	...	...	24	16.103	5.652
Every six months	18	9.003	3.079	26	11.434	3.945	24	10.819	3.797
Total	129	80.997	27.699	168	105.876	36.528	188	96.739	33.955

TABLE I.—*Tapping intervals*—Continued

Tapping intervals	March, 1927			April, 1927			May, 1927		
	Tapping days	Latex in liters	Dry rubber	Tapping days	Latex in liters	Dry rubber	Tapping days	Latex in liters	Dry rubber
			Kilos			*Kilos*			*Kilos*
Daily	25	36.071	13.491	27	20.748	7.511	25	26.005	9.336
Alternate daily	14	8.653	3.236	13	7.073	2.560	13	9.360	3.360
Every two days	13	3.808	1.424	15	4.515	1.634	14	5.086	1.826
Every three days	11	3.667	1.371	14	4.029	1.458	12	3.576	1.284
Every four days	12	6.772	2.543	14	4.254	1.540	15	5.379	1.931
Every five days	12	7.381	2.760	11	6.123	2.217	10	5.981	2.147
Every six days	14	2.663	0.996	12	1.818	0.658	12	2.362	0.848
Alternate weekly	12	5.345	1.999	12	4.318	1.563	12	7.329	2.631
Alternate bi-weekly	13	8.327	3.114	13	5.434	1.967	13	7.179	2.577
Alternate tri-weekly	8	2.378	0.889	8	2.817	1.020	20	5.291	1.899
Alternate monthly	......	....	....	27	18.692	6.762	......	....	....
Every six months	25	9.112	3.408	26	7.797	2.823	......	....	....
Total	159	94.177	35.231	192	87.618	31.713	146	77.548	27.839

Tapping intervals	June, 1927			July, 1927			August, 1927		
	Tapping days	Latex in liters	Dry rubber	Tapping days	Latex in liters	Dry rubber	Tapping days	Latex in liters	Dry rubber
			Kilos			*Kilos*			*Kilos*
Daily	28	14.836	6.053	23	10.552	3.778	23	21.012	9.098
Alternate daily	14	7.477	3.050	12	7.629	2.731	12	5.864	2.539
Every two days	14	5.208	2.125	14	7.334	2.626	13	6.034	2.613
Every three days	12	4.043	1.649	13	5.769	2.065	13	3.411	1.477
Every four days	11	3.877	1.582	15	9.866	3.532	12	7.463	3.231
Every five days	14	5.654	2.307	14	8.668	3.103	8	5.467	2.367
Every six days	10	2.289	0.934	13	5.324	1.907	9	1.419	0.614
Alternate weekly	16	5.816	2.373	13	5.724	2.049	10	3.693	1.599
Alternate bi-weekly	16	6.296	2.569	14	8.024	2.873	15	7.852	3.300
Alternate tri-weekly	20	4.042	1.649	8	1.385	0.496	10	1.410	0.611
Alternate monthly	28	16.051	6.549	......	....	....	23	12.815	5.549
Every six months	......	....	....	......	....	....	......	....	....
Total	183	75.589	30.840	139	70.275	25.160	148	76.440	32.998

Tapping intervals	Actual yield			Number of days tapped	Number of trees tapped
	Latex in liters	Dry rubber			
		Total	Per tree		
		Kilos	*Kilos*		
Daily	353.414	135.059	3.972	369	34
Alternate daily	116.648	44.977	1.406	182	32
Every two days	54.775	20.284	0.845	129	24
Every three days	50.269	18.443	0.768	117	24
Every four days	69.111	25.507	1.063	124	24
Every five days	68.140	25.073	1.045	115	24
Every six days	32.960	11.969	0.499	111	24
Alternate weekly	92.188	35.435	1.107	194	32
Alternate bi-weekly	109.113	41.979	1.312	193	32
Alternate tri-weekly	47.967	18.547	0.580	205	32
Alternate monthly	128.115	49.587	1.550	201	32
Every six months	60.605	21.680	0.903	139	24
Total	1,183.305	448.540	15.050	2,079	338

TABLE I.—*Tapping intervals*—Continued

Tapping intervals	Average girth 3-feet from ground	Rainy days
	Inches	
Daily	37.32	79 rainy days and no tapping was practicable.
Alternate daily	33.49	39 rainy days and no tapping was practicable.
Every two days	26.00	23 rainy days and no tapping was practicable.
Every three days	26.87	33 rainy days and no tapping was practicable.
Every four days	28.87	29 rainy days and no tapping was practicable.
Every five days	34.89	32 rainy days and no tapping was practicable.
Every six days	27.26	39 rainy days and no tapping was practicable.
Alternate weekly	26.41	21 rainy days and no tapping was practicable.
Alternate bi-weekly	28.57	17 rainy days and no tapping was practicable.
Alternate tri-weekly	24.32	
Alternate monthly	35.43	40 rainy days and no tapping was practicable.
Every six months	32.08	44 rainy days and no tapping was practicable.
Total	338.99	

Tapping at two-, three-, four-, five-, six-day and six-month intervals began October 29, 1926; and daily, alternate daily, weekly, bi-weekly, tri-weekly and monthly on May 31, 1926.

The highest yielding months of the different tapping intervals were March and August for the daily tapping, July and August for the alternate day, July and August for the two-day, November and January for the three-day, July and November for the four-day, January and July for the five-day, July and December for the six-day, July and November for the weekly, June and August for the bi-weekly, June and October for the tri-weekly, August and October for the monthly, and January and November for the six-month intervals. The highest yield and rubber content per liter of latex were obtained during July and August. However, during the month of June, a rubber content of 0.477 kilogram per liter of latex was also obtained as compared with 0.496 and 0.433 kilogram for July and August, respectively, but the yield was less than that of July and August because of less latex produced during the month.

Of the various tapping intervals that were tried during the period, the daily tapping gave the highest total yield for the whole period, the alternate month second, the alternate day third and the bi-weekly fourth. The corresponding yields were 135.059, 49.587, 44.977, and 41.979 kilograms of dry rubber, respectively, or equivalent to 3.972, 1.55, 1.406 and 1.312 kilograms of dry rubber per tree for the whole period.

The effect of the brown-bast, which has been reported to be mainly due to the excessive tapping of Para rubber, has so far not yet been observed on the trees in the plantation even on those tapped daily.

The trees in the alternate weekly and tri-weekly sections gave lower yields, probably owing to the severe injury done to them by people and animals, and their bark has become rather knotty and difficult to tap. Besides the land where the trees are planted is rather poorly drained. The trees in the alternate daily, alternate bi-weekly, alternate monthly and those trees tapped daily have also suffered injury in the same manner although not so severe as the other two sections; namely, the alternate weekly and tri-weekly sections.

Table II shows the monthly yields obtained from the different tapping systems from July 1926 to August 1927.

TABLE II.—*Tapping system*

Month	Half-spiral							
	Daily				Alternate daily			
	Number of trees	Days tapped	Latex	Dry rubber	Number of trees	Days tapped	Latex	Dry rubber
			Liters	*Kilos*			*Liters*	*Kilos*
July 1926	44	26	41.563	14.921	44	12	22.257	7.990
August 1926	44	28	45.059	15.635	44	15	38.533	13.371
September 1926	44	25	27.768	9.330	44	13	19.490	6.549
October 1926	44	25	18.945	6.896	44	11	15.193	5.530
November 1926	44	18	21.498	7.395	44	8	13.794	4.745
December 1926	44	18	17.217	5.733	44	8	14.537	4.841
January 1927	44	26	29.199	9.490	44	12	27.304	8.874
February 1927	44	24	29.186	9.719	44	11	22.312	7.430
March 1927	44	25	20.066	7.184	44	14	17.354	6.213
April 1927	44	27	15.322	5.225	44	13	10.834	3.694
May 1927	44	25	18.199	6.297	44	12	13.888	4.805
June 1927	44	26	8.429	2.874	44	12	16.154	5.509
July 1927	44	26	20.013	6.744	44	14	15.747	5.307
August 1927	44	23	14.382	6.026	44	10	7.724	3.236
Total	616	342	326.846	113.469	616	165	255.121	88.094

Month	Half-spiral				V-shaped					
	Total yield				Daily				Alternate daily	
	Number of trees	Days tapped	Latex	Dry rubber	Number of trees	Days tapped	Latex	Dry rubber	Number of trees	Days tapped
			Liters	*Kilos*			*Liters*	*Kilos*		
July 1926	88	38	63.820	22.911	47	26	87.812	31.525	47	12
August 1926	88	43	83.592	29.006	47	28	32.944	11.432	47	15
September 1926	88	38	47.258	15.879	47	25	14.867	4.995	47	13
October 1926	88	36	34.138	12.426	47	25	13.444	4.894	47	11
November 1926	88	26	35.292	12.140	47	18	8.280	2.848	47	8
December 1926	88	26	31.754	10.574	47	18	5.364	1.786	47	8
January 1927	88	38	56.503	18.364	47	26	9.564	3.108	47	12
February 1927	88	35	51.498	17.149	47	24	14.780	4.922	47	11
March 1927	88	39	37.420	13.397	47	25	21.187	7.585	47	14
April 1927	88	40	26.156	8.919	47	27	24.437	8.333	47	13
May 1927	88	37	32.087	11.102	47	25	31.207	10.798	47	12
June 1927	88	38	24.583	8.383	47	26	13.999	4.674	47	12
July 1927	88	40	35.760	12.051	47	26	33.357	11.241	47	14
August 1927	88	33	22.106	9.262	47	23	22.960	9.620	......	......
Total	1,232	507	581.967	201.563	658	342	334.202	117.761	611	155

TABLE II.—*Tapping system*—Continued

Month	V—Shaped						Opposite—V			
	Alternate daily		Total yield				Daily			
	Latex	Dry rubber	Number of trees	Days tapped	Latex	Dry rubber	Number of trees	Days tapped	Latex	Dry rubber
	Liters	*Kilos*			*Liters*	*Kilos*			*Liters*	*Kilos*
July 1926	45.704	16.408	94	38	133.516	47.933	......	......	....	......
August 1926	37.934	13.163	94	43	70.878	24.595	......	......	....	......
September 1926	15.103	5.075	94	38	29.970	10.070	......	......	....	......
October 1926	14.108	5.135	94	36	27.552	10.029	......	......	....	......
November 1926	9.725	3.345	94	26	18.005	6.193	......	......	....	......
December 1926	5.006	1.667	94	26	10.370	3.453	......	......	....	......
January 1927	7.269	2.362	94	38	16.833	5.470	40	13	14.072	4.573
February 1927	3.311	1.103	94	35	18.091	6.025	40	24	34.261	11.409
March 1927	2.403	0.860	94	39	23.590	8.445	40	25	24.518	8.777
April 1927	1.534	0.523	94	40	25.971	8.856	40	27	18.752	6.394
May 1927	1.897	0.656	94	37	33.104	11.454	40	25	19.830	6.861
June 1927	3.385	1.154	94	38	17.384	5.828	40	26	24.637	8.401
July 1927	6.286	2.118	94	40	39.643	13.359	40	26	24.235	8.167
August 1927	(a)	(a)	47	23	22.960	9.620	40	23	12.754	5.344
Total	153.665	53.569	1,269	497	487.867	171.330	320	189	173.059	59.926

[a] Rested.

Comparing the yields of 44 trees each of the half-spiral with an average girth of 29.85 inches three feet from the ground and the V-shaped cut with an average girth of 33.51 inches both tapped daily, it was found that the former system yielded 113.469 kilos of dry rubber during the fourteen months or 342 tapping days against 110.244 kilos by the V-shaped method, or an increase of 3.225 kilos over the latter. In the alternate day tapping, however, the 44 trees tapped half-spiral with an average girth of 32.22 inches yielded 37.942 kilos of dry rubber more than the 44 trees tapped V-shaped with an average girth of 27.93 inches during the period of 165 and 155 tapping days, respectively. Taking the total yields of the 44 trees with an average girth of 31.03 inches tapped in half-spirals and the 47 trees with an average girth of 30.72 inches tapped by the V-shaped method both daily and alternate daily, the former gave 30.233 kilos of dry rubber more than the latter system. During the course of the experiment it was noticed that the monthly yields by the half-spiral was almost regular while the V-shaped declined gradually until most of the trees especially those tapped alternate days had to be given a rest because of latex exhaustion. Besides the general health condition of the trees became very poor due to the greater injury received by the trees tapped by the V-shaped sytem. Nevertheless no brownbast has so far been found on the trees. The bark consumption and the cost of tapping of the trees by the V cut was so great that this system is not recommended in estate practice.

As to the yield of the 40 trees tapped daily in opposite V's with an average girth of 26.20 inches when compared with the yields of the same number of trees tapped daily in half-spiral and V-shaped cuts, the opposite V's yielded 59.926 kilos of dry rubber during the eight months or 189 tapping days, while the half-spiral and the V-shaped gave only 48.651 and 51.307 kilos of dry rubber, respectively, in 202 tapping days. The two V's were opened in opposite directions on the trunk of each tree, one being placed one foot and the other three feet from the ground. Each of the opposite V's was tapped on alternate days, but the trees were tapped daily.

Table III gives the results obtained from the trees tapped once and twice a day from July 1926 to August 22, 1927.

The average girths measured three feet from the ground of the trees in the experiment were as follows:

32.77 inches of the trees tapped daily and twice a day incisions
25.87 inches of the trees tapped alternate days and twice a day incisions
33.44 inches of the trees tapped daily in the afternoon
32.27 inches of the trees tapped alternate days in the afternoon
29.85 inches of the trees tapped daily in the morning
32.22 inches of the trees tapped alternate days in the morning

The highest rubber content per liter of latex was obtained during the month of August under all conditions of the experiment, or 0.419 kilo for the morning tapping, 0.3942 kilo for the afternoon tapping both tapped once a day, and 0.4619 and 0.6021 kilo for tapping twice a day—morning and afternoon, respectively. The afternoon tappings of once and twice a day gave higher rubber content than the morning tappings, which averaged 0.3549 kilo per liter of latex for the afternoon tapping once a day and 0.3671 kilo for the afternoon tapping twice a day during the whole period of the experiment against 0.3488 and 0.3159 kilo for the morning tappings once and twice a day.

Using the half-spiral system of continuous daily tapping once a day only, the yield for the afternoon tapping was comparatively higher than for the morning tapping in spite of the established principle that the morning tapping of Para rubber gives decidedly more latex than that of any other time of the day. The average yield per tree of the trees tapped daily in the afternoon was 3.044 kilos of dry rubber against 2.578 kilos in the morning

(*a*) Para rubber tree tapped in opposite V's at the Halcon Rubber Sub-station, Baco, Mindoro

(*b*) Para rubber tree tapped two feet from the ground at the Halcon Rubber Sub-station, Baco, Mindoro

during the 342 tapping days, while the alternate day tapping gave the yields of 2.002 and 1.989 kilos of dry rubber in favor of the morning tapping during the 165 tapping days. Taking the total average yield of the daily and the alternate day tappings, the yield per tree of the morning tapping was 2.29 kilos of dry rubber and 2.477 kilos for the afternoon tapping during the 507 tapping days, or a difference of 0.187 kilo in favor of the afternoon tapping. It has been observed that if the weather is favorable and tapping is started as late as three o'clock in the afternoon, tapping Para rubber in the afternoon is advisable provided that the latex can be coagulated before night.

Tapping the trees twice a day—morning and afternoon—both daily and alternate days, the morning tappings gave better yields than the afternoon tappings. The total average yield per tree of the morning daily and alternate day tappings was 1.025 during the 348 tapping days, against 0.959 kilo of dry rubber for the afternoon tapping during the 395 tapping days. The yields of the morning tappings alone were 1.205 kilos of dry rubber per tree for the daily and 0.845 kilo for the alternate days during the 227 and 121 tapping days, respectively, while the afternoon tapping yielded only 1.149 and 0.768 kilo of dry rubber during the 260 and 135 tapping days. In this experiment, too, the daily tapping yielded more than that of the alternate days or a difference of 0.371 kilo of dry rubber per tree during the periods of 487 and 256 tapping days in the alternate days.

Comparing the average total yields per tree of the trees tapped once a day in the morning as well as in the afternoon with the yield of the trees tapped twice a day—morning and afternoon—shows that the trees tapped once in the afternoon yielded 1.931 kilos of dry rubber per tree during th 395 tapping days, while those tapped once a day in the morning and twice a day—morning and afternoon—yielded only 1.784 and 0.954 kilos of dry rubber, respectively, during the same number of tapping days. It may therefore be concluded from the present experiment that tapping twice a day is impracticable not only because of the lower yield attained, but also the cost of operation and the possible effect of diseases on the trees due to excessive tapping.

TABLE III.—*Tapping once and twice a day*

ONCE A DAY

Month	Morning tapping—check											
	Daily				Alternate daily				Total yield			
	Number of trees	Number of days tapped	Latex	Dry rubber	Number of trees	Number of days tapped	Latex	Dry rubber	Number of trees	Number of days tapped	Latex	Dry rubber
			Liters	*Kilos*			*Liters*	*Kilos*			*Liters*	*Kilos*
July 1926	44	26	41.563	14.921	44	12	22.257	7.990	88	38	63.820	22.911
August 1926	44	28	45.059	15.635	44	15	38.533	13.371	88	43	83.592	29.006
September 1926	44	25	27.768	9.330	44	13	19.490	6.549	88	38	45.258	15.879
October 1926	44	25	18.945	6.896	44	11	15.193	5.530	88	36	34.138	12.426
November 1926	44	18	21.498	7.395	44	8	13.794	4.745	88	26	35.292	12.140
December 1926	44	18	17.217	5.733	44	8	14.537	4.841	88	26	31.754	10.574
January 1927	44	26	29.199	9.490	44	12	27.304	8.874	88	38	56.503	18.364
February 1927	44	24	29.186	9.719	44	11	22.312	7.430	88	35	51.498	17.149
March 1927	44	25	20.066	7.184	44	14	17.354	6.213	88	39	37.420	13.397
April 1927	44	27	15.322	5.225	44	13	10.834	3.694	88	40	26.156	8.919
May 1927	44	25	18.199	6.297	44	12	13.888	4.805	88	37	32.087	11.102
June 1927	44	26	8.429	2.874	44	12	16.154	5.509	88	38	24.583	8.383
July 1927	44	26	20.013	6.744	44	14	15.747	5.307	88	40	35.760	12.051
August 1927	44	23	14.382	6.026	44	10	7.724	3.236	88	33	22.106	9.262
Total	616	342	326.846	113.469	616	165	255.121	88.094	1,232	507	581.967	201.563

(*a*) Para rubber tree tapped four feet from the ground at the Halcon Rubber Sub-station, Baco, Mindoro

(*b*) Showing a portion of the Para rubber trees planted on a level plain at the Halcon Rubber Sub-station, Baco, Mindoro

TABLE III.—*Tapping once and twice a day*—Continued

TWICE A DAY

Month	Morning tapping											
	Daily				Alternate daily				Total yield			
	Number of trees	Number of days tapped	Latex	Dry rubber	Number of trees	Number of days tapped	Latex	Dry rubber	Number of trees	Number of days tapped	Latex	Dry rubber
			Liters	*Kilos*			*Liters*	*Kilos*			*Liters*	*Kilos*
October 1926	30	4	1.915	0.692	30	1	0.458	0.165	60	5	2.373	0.857
November 1926	30	19	18.776	6.641	30	10	9.564	3.383	60	29	28.340	10.024
December 1926	30	18	11.829	3.963	30	11	6.795	2.276	60	29	18.624	6.239
January 1927	30	26	17.502	5.208	30	14	10.057	2.992	60	40	27.559	8.200
February 1927	30	23	12.627	3.500	30	13	9.130	2.531	60	36	21.757	6.031
March 1927	30	23	9.726	3.719	30	11	4.488	1.716	60	34	13.214	5.435
April 1927	30	26	6.108	2.173	30	14	6.520	2.320	60	40	12.628	4.493
May 1927	30	22	2.677	0.826	30	13	10.143	3.130	60	35	12.820	3.956
June 1927	30	19	7.494	3.050	30	11	7.918	3.223	60	30	15.412	6.273
July 1927	30	25	11.962	3.486	30	13	8.194	2.388	60	38	20.156	5.874
August 1927	29	22	6.290	2.905	29	10	2.688	1.242	58	32	8.978	4.147
Total	329	227	106.906	36.163	329	121	75.955	25.366	658	348	182.861	61.529

Month	Afternoon tapping											
	Daily				Alternate daily				Total yield			
	Number of trees	Number of days tapped	Latex	Dry rubber	Number of trees	Number of days tapped	Latex	Dry rubber	Number of trees	Number of days tapped	Latex	Dry rubber
			Liters	*Kilos*			*Liters*	*Kilos*			*Liters*	*Kilos*
October 1926	30	5	2.250	0.887	30	2	0.668	0.263	60	7	2.918	1.150
November 1926	30	23	17.375	4.768	30	13	10.762	2.953	60	36	28.137	7.721
December 1926	30	26	14.170	5.257	30	13	7.998	2.967	60	39	22.168	8.224
January 1927	30	30	15.356	4.902	30	16	10.363	3.308	60	46	25.719	8.210
February 1927	30	27	11.334	3.499	30	15	6.963	2.149	60	42	18.297	5.648
March 1927	30	31	12.245	4.630	30	13	5.554	2.100	60	44	17.799	6.730
April 1927	30	30	6.530	1.916	30	15	6.390	1.875	60	45	12.920	3.791
May 1927	30	23	1.952	0.809	30	14	4.557	1.889	60	37	6.509	2.698
June 1927	30	19	4.660	1.583	30	12	6.519	2.214	60	31	11.179	3.797
July 1927	30	23	9.463	3.243	30	11	5.968	2.045	60	34	15.431	5.288
August 1927	30	23	4.990	3.004	30	11	2.124	1.279	60	34	7.114	4.283
Total	330	260	100.325	34.498	330	135	67.866	23.042	660	395	168.191	57.540

(*a*) Showing a portion of the Para rubber trees planted on hilly ground at the Halcon Rubber Sub-station, Baco, Mindoro

(*b*) A portion of the Para rubber trees tapped in a V-shaped cut at the Halcon Rubber Sub-station, Baco, Mindoro

TABLE IV.—*Tapping heights*

Month (1927)	Two feet					Three feet					Four feet				
	Number of trees	Days tapped	Latex	Dry rubber	Rubber content	Number of trees	Days tapped	Latex	Dry rubber	Rubber content	Number of trees	Days tapped	Latex	Dry rubber	Rubber content
			Liters	*Kilos*	*Per cent*			*Liters*	*Kilos*	*Per cent*			*Liters*	*Kilos*	*Per cent*
January 29 to February 28	15	26	8.556	2.947	34.44	15	26	4.830	2.093	43.33	15	26	8.320	3.210	38.58
March	15	29	7.641	2.934	38.39	15	29	5.167	1.964	38.01	15	29	8.116	3.326	40.98
April	15	27	6.208	1.419	22.85	15	27	3.106	1.180	37.99	15	27	5.709	1.469	25.73
May	15	26	7.888	2.088	26.47	15	26	3.823	1.426	37.30	15	26	6.353	2.064	32.48
June	15	29	5.717	1.789	31.29	15	29	2.097	1.023	48.78	15	29	4.785	1.692	35.40
July	15	24	4.053	1.480	36.51	15	24	2.418	0.883	36.51	15	24	3.782	1.381	36.51
August	15	22	3.384	1.625	48.02	15	22	1.517	0.733	48.31	15	22	2.748	1.059	38.53
Total	105	180	43.447	15.165	237.97	105	180	22.958	9.993	290.20	105	180	39.813	15.082	248.21

Table IV indicates the results obtained from the trees tapped daily at different heights from January 29 to August 31, 1927.

One of the trees tapped 2 feet, three of the 3-foot, and one of the 4-foot were rested in August due to poor condition.

The girths of the trees tapped at different heights were as follows: 21.12 to 32.44 with an average of 25.5 inches of the 2-foot, 18.62 to 47.62 with an average of 27.24 inches of the 3-foot and 22.56 to 29.62 with an average of 24.8 inches of the 4-foot.

The monthly yields in dry rubber of each of the experiments were recorded separately till July 15 when by mistake the latex of the three conditions after it had been measured was mixed and coagulated together so that the yields and the percentage of dry rubber for the months of July and August were calculated from the total dry rubber produced.

The trees tapped 2 feet high gave the highest yield both in latex and dry rubber during the seven months' tapping, then the 4-foot trees second, and the 3-foot trees last. The corresponding yields of each were 43.447 liters latex and 15.165 kilos dry rubber of the 2-foot trees, 39.813 liters latex and 15.082 kilos dry rubber of the 4-foot trees, and 22.958 liters latex and 9.993 kilos dry rubber of the 3-foot trees. The trees tapped 3 feet high yielded 40.40 per cent rubber content during the five months' tapping as compared with only 31.04 per cent and 35.33 per cent for the trees tapped 2 feet and 4 feet, respectively.

The relative merits of the best yielding trees tapped differently at the Halcon Rubber Sub-station, Baco, Mindoro, are given below:

Tapping intervals

[From May 31, 1926 to August 31, 1927]

Daily			Alternate daily			Alternate week		
Tree number	Girth	Dry rubber	Tree number	Girth	Dry rubber	Tree number	Girth	Dry rubber
	Inches	*Kilos*		*Inches*	*Kilos*		*Inches*	*Kilos*
161	44.3	7.663	3	37.3	2.890	43	44.7	2.176
168	34.5	6.791	16	28.6	2.062	49	35.8	2.153
170	37.1	6.021	17	41.8	2.232	50	29.4	2.391
173	45.1	8.418	20	30.2	3.356	51	29.8	3.134
174	28.3	5.218	23	39.3	4.304			
175	39.8	6.459	25	35.6	2.064			
177	48.1	13.009	26	40.1	2.345			
179	39.7	5.299						
181	51.6	6.986						
187	60.5	5.462						

Tapping intervals—Continued

[From May 31, 1926 to August 31, 1927]

Alternate two-weeks			Alternate three-weeks			Alternate monthly		
Tree number	Girth	Dry rubber	Tree number	Girth	Dry rubber	Tree number	Girth	Dry rubber
	Inches	*Kilos*		*Inches*	*Kilos*		*Inches*	*Kilos*
84	54.8	2.126	100	24.5	1.118	137	54.5	5.054
86	35.7	4.011	108	26.6	1.281	138	36.5	2.340
87	47.1	5.275	109	24.5	1.120	144	39.3	4.300
88	29.3	3.444	122	23.0	1.357	148	33.5	3.436
89	24.5	2.024				151	41.5	2.957
91	28.5	2.584				152	48.0	3.357
						155	57.5	2.866
						157	50.5	3.784

[From October 29, 1926 to August 31, 1927]

Two-day intervals			Three-day intervals			Four-day intervals		
Tree number	Girth	Dry rubber	Tree number	Girth	Dry rubber	Tree number	Girth	Dry rubber
	Inches	*Kilos*		*Inches*	*Kilos*		*Inches*	*Kilos*
200	27.8	1.646	228	38.0	1.489	244	57.3	1.879
201	25.2	1.766	232	41.0	1.756	246	30.8	2.077
205	25.7	1.628	240	29.2	1.988	247	24.1	1.802
213	26.8	1.868	241	33.5	2.632	252	29.5	2.313
						260	24.3	1.953
						265	25.1	2.129

Five-day intervals			Six-day intervals			Six-month intervals		
Tree number	Girth	Dry rubber	Tree number	Girth	Dry rubber	Tree number	Girth	Dry rubber
	Inches	*Kilos*		*Inches*	*Kilos*		*Inches*	*Kilos*
274	45.0	4.162	293	26.5	1.033	315	27.8	2.119
282	41.6	5.210	307	25.2	1.018	320	36.4	2.524
285	34.3	3.381	309	35.2	2.126	321	34.7	1.880

Tapping system

Half-spiral [a]					
Daily			Alternate day		
Tree number	Girth	Dry rubber	Tree number	Girth	Dry rubber
	Inches	*Kilos*		*Inches*	*Kilos*
1	34.5	3.728	53	38.8	2.966
2	36.6	4.248	57	31.3	3.707
13	31.5	4.371	60	44.5	6.112
17	42.5	5.050	65	33.1	3.898
21	42.9	3.897	66	37.2	3.023
23	33.6	4.899	67	40.0	3.566
26	37.8	5.453	69	50.3	3.899
31	25.9	4.320	78	45.8	2.921
38	28.5	4.249	80	42.5	4.784
44	40.3	5.329	81	38.5	2.671

[a] Tapped from July 1926 to August 1927.

Tapping system—Continued

V-shape [a]						Opposite V's [b]		
Daily			Alternate day			Daily		
Tree number	Girth	Dry rubber	Tree number	Girth	Dry rubber	Tree number	Girth	Dry rubber
	Inches	*Kilos*		*Inches*	*Kilos*		*Inches*	*Kilos*
90	40.6	8.584	138	39.1	3.213	185	37.6	5.503
93	41.1	3.666	139	31.6	2.701	188	40.3	3.185
96	30.4	4.950	148	35.8	2.814	192	37.5	3.157
110	36.5	4.819	181	34.1	2.199	195	31.7	3.628
122	41.7	3.596				207	31.5	4.112
126	51.7	4.476				214	31.3	2.215
128	41.6	3.664				215	27.1	2.542
130	26.3	4.744				216	41.3	2.980
131	49.9	4.437				221	29.2	2.701
132	42.5	7.052				222	30.7	2.407

[a] Tapped from July 1926 to August 1927.
[b] Tapped from January to August 1927.

Tapping once and twice a day

Twice a day (a. m. and p. m.) [a]						Once a day (p. m.) [b]					
Daily			Alternate daily			Daily			Alternate daily		
Tree number	Girth	Dry rubber	Tree number	Girth	Dry rubber	Tree number	Girth	Dry rubber	Tree number	Girth	Dry rubber
	Inches	*Kilos*		*Inches*	*Kilos*		*Inches*	*Kilos*		*Inches*	*Kilos*
5	35.9	3.358	41	37.2	4.703	7	48.1	6.863	71	31.2	5.954
9	36.6	5.948	50	22.5	3.133	11	36.1	6.228	76	27.3	3.582
10	34.6	4.021	51	39.8	5.420	25	44.8	5.059	82	26.2	3.464
13	40.1	4.548	59	29.1	4.817	35	44.7	4.655	91	44.7	3.499
15	30.4	4.337				37	38.1	7.286	103	40.4	3.770
19	31.1	4.005				39	27.8	4.599	111		3.771
22	37.0	5.489				41	38.1	4.833	118		3.425
24	44.5	3.024				45	32.5	4.874	123		3.002
						49	39.1	5.429	124		5.679
						61	36.8	5.844			

[a] Tapped from October 27, 1926 to August 31, 1927.
[b] Tapped from July 1, 1926 to August 22, 1927.

The three highest yielding trees are as follows:

Tapping intervals:

Trees No. 161, 173, and 177 of the trees tapped daily

Trees No. 3, 20, and 23 of the trees tapped alternate days

Trees No. 43, 50, and 51 of the trees tapped alternate weeks

Trees No. 86, 87, and 88 of the trees tapped alternate two weeks

Trees No. 108, 109, and 122 of the trees tapped three weeks alternate

Trees No. 137, 144, and 148 of the trees tapped alternate months

Trees No. 200, 201, and 213 of the trees tapped daily at two days' interval

Trees No. 232, 240, and 241 of the trees tapped daily at three days' interval

Tres No. 246, 252, and 265 of the trees tapped daily at four days' interval

Trees No. 274, 282, and 285 of the trees tapped daily at five days' interval

Tapping intervals—Continued.

Trees No. 293, 307, and 309 of the trees tapped daily at six days' interval

Trees No. 315, 320, and 321 of the trees tapped daily at six months' interval

Tapping systems:

Trees No. 17, 26, and 44 of the trees tapped daily in half-spiral cut

Trees No. 60, 69, and 80 of the trees tapped alternate days in half-spiral cut

Trees No. 90, 96, and 132 of the trees tapped daily in V-shaped cut

Trees No. 138, 139, and 148 of the trees tapped alternate days in V-shaped cut

Trees No. 185, 195, and 207 of the trees tapped daily in opposite V's cuts

Tapping once and twice a day:

Trees No. 9, 13, and 22 of the trees tapped daily and twice a day

Trees No. 41, 51, and 59 of the trees tapped alternate days and twice a day

Trees No. 7, 11, and 37 of the trees tapped daily in the afternoon

Trees No. 71, 111, and 124 of the trees tapped alternate days in the afternoon

Deducing the possible yearly yields per tree of the trees tapped differently if tappings have been done during the whole period without any interruptions whatsoever, because of unfavorable weather conditions, plant diseases, absences of the tappers, etc., the following yields might be expected from the trees yearly:

Tapping intervals

	Tapping days	Yield per tree
		Kilos
Daily	365	3.929
Alternate days	182	1.406
Every two days	182	1.192
Every three days	183	1.201
Every four days	184	1.577
Every five days	185	1.681
Every six days	185	0.831
Weekly alternate	182	1.039
Two weeks alternate	91	0.618
Three weeks alternate	63	0.182
Alternate months	182	1.465
Alternate six months	182	1.182

Tapping systems

Half-spiral daily	365	2.752
Half-spiral alternate days	182	2.208
V-shape daily	365	2.673
V-shape alternate days	182	1.338
Opposite V's daily	365	2.888

Tapping once and twice a day

	Tapping days	Yield per tree
		Kilos
Once a day in the morning daily	365	2.752
Once a day in the morning alternate days	182	2.208
Once a day in the afternoon daily	365	3.248
Once a day in the afternoon alternate days	182	2.084
Twice a day morning and afternoon daily	730	3.529
Twice a day morning and afternoon alternate days	364	2.294

Tapping heights

Two-feet daily	365	2.049
Three-feet daily	365	1.351
Four-feet daily	365	2.038

PROGRESS REPORT ON THE STORAGE AND CURING OF MANDARIN ORANGES AT THE TANAUAN CITRUS EXPERIMENT STATION

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The Tanauan Citrus Experiment Station started, in 1920, a series of experiments on the storage and curing of the Batangas mandarin orange. The objects were to find a means of storing the fruit so as to lengthen the period of time in which it may be marketed, and also to improve the color and quality of the fruit. It was deemed important, moreover, that such a means should be convenient and cheap enough for the growers in the citrus district to practice.

It was determined in 1920 that it was possible to store the fruit in an underground storage chamber for a longer period of time than was usually thought possible. These preliminary investigations showed that the fruit could be made to assume a uniform orange color and in addition its general quality considerably improved. The curing of the oranges was entirely accomplished fourteen to twenty days after placing them in the vault. These experiments, however, showed that twenty days was the limit of time that it was economically possible to store the fruit. After that period the loss was so great that storing would not be economically feasible using the methods employed.

Data were also obtained in these first experiments which showed that there was a larger loss in clipped fruits than in those picked by the ordinary way; that a slightly larger loss was found in the green than in the ripe fruit; and that the size of fruit did not make any difference in its keeping quality.

All these results were obtained with fruits that were not treated with any disinfecting solutions. The unventilated, underground storage chamber which was used was described in the account of the experiments which was published in the Philippine Agricultural Review, Vol. 13, pages 214–217, 1920.

Year 1923.—In 1923 the storing was done in an underground chamber made very much like the one previously used except that it was provided with a chimney, one foot in diameter, so that a slow current of air passing through the chamber resulted. A tight door was also provided to exclude the entrance of warm drafts during the daytime. During the night this door was kept open.

The fruits used in the experiments were all harvested during the month of January, and were in about the same stage of maturity. Two methods were used in picking the fruit—one was by clipper, so as to leave a short portion of the stem on the fruit, and the other one was by the ordinary Batangas method, i.e., by pulling and twisting the fruit, leaving no portion of the stem.

The fruits were separated into lots treated as follows: (1) check, not disinfected; (2) immersed in 0.2 per cent solution of formalin, some lots for 3 minutes and others for 5 minutes; (3) immersed in 0.018 per cent solution of copper sulphate, some lots for 3 minutes and others for 5 minutes; and (4) immersed for 5 minutes in potassium permanganate solutions of 0.018, 0.025, and 0.05 per cent concentrations. Each lot of fruits was placed in storage two days after picking, and the different lots were similarly exposed to the open air, previous to storing them in the chamber.

Table I bears a general summary of the results obtained in these experiments. Of the 1,587 fruits used, the check lots had 419 fruits, the lots disinfected with formalin, 419, the lots disinfected with copper sulphate solution, 419, and the lots disinfected with potassium permanganate solution, 33 fruits.

These results indicate that there was distinctly less decay of fruit in the lots treated with permanganate solution than in the others. After six weeks of storage, the average loss of fruit in the lots disinfected with potassium permanganate was 25.8 per cent, in those of the check, 32.7 per cent, in the formalin lots, 33.1 per cent and in the copper sulphate lots, 34.8 per cent. After eleven weeks of storage, the lots disinfected with potassium permanganate showed an average loss of 73.9 per cent, the formalin lots, 79.5 per cent, the check lots, 80.0 per cent, the copper sulphate lots, 82.3 per cent. The marked superiority shown by the potassium permanganate over the other disinfectants cannot be accounted for, unless it is that it might be more effective in killing the organism causing most of the decay, or, that the concentrations of the formalin and copper sulphate solutions used were too weak to be effective.

TABLE I.—*Showing the percentage of decay in fruits of the Batangas mandarin orange, treated with various disinfectants, and cured and stored in an underground, ventilated chamber*

Treatment of fruit	Kind of fruit	Date placed in storage	Number	Fruit decayed							
				First week		Second week		Third week		Fourth week	
				Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Check:											
No treatment	Clipped, stem on	Jan 6, 1923	66	0	0	0	0	2	3.0	7	10.6
Do	do	Jan 13, 1923	80	1	1.3	1	1.3	5	6.3	11	13.8
Do	Picked, no stem	do	123	2	1.6	4	3.3	4	3.3	16	13.0
Do	do	Jan 20, 1923	150	0	0	9	6.0	21	14.0	27	18.0
Totals			419	3	0.7	14	3.3	32	7.6	61	14.6
Formalin solution:											
0.2 per cent, 3 minutes	Clipped, stem on	Jan 6, 1923	66	0	0	1	1.5	7	10.6	13	19.7
Do	do	Jan 13, 1923	80	0	0	1	1.3	2	2.5	4	5.0
Do	Picked, no stem	do	123	0	0	0	0	2	1.6	7	5.7
0.2 per cent, 5 minutes	do	Jan 20, 1923	150	0	0	4	2.7	14	9.3	22	14.7
Totals			419	0	0	6	1.4	27	6.4	46	11.0
Copper sulphate solution:											
0.018 per cent, 3 minutes	Clipped, stem on	Jan 6, 1923	66	1	1.5	1	1.5	7	10.6	15	22.7
Do	do	Jan 13, 1923	80	3	3.8	5	6.3	7	8.8	10	12.5
Do	Picked, no stem	do	123	0	0	0	0	1	0.8	5	4.1
0.018 per cent, 5 minutes	do	Jan 20, 1923	150	1	0.7	9	6.0	21	14.0	30	20.0
Totals			419	5	1.2	15	3.6	36	8.6	60	14.3
Potassium permanganate solution:											
0.025 per cent, 5 minutes	Clipped, stem on	Jan 13, 1923	90	0	0	0	0	0	0	3	3.3
0.05 per cent, 5 minutes	do	do	90	0	0	1	1.1	4	4.4	8	8.9
0.018 per cent, 5 minutes	Picked, no stem	Jan 20, 1923	150	1	0.7	5	3.3	12	8.0	23	15.3
Totals			330	1	0.3	6	1.8	16	4.8	34	10.3

TABLE I.—*Showing the percentage of decay in fruits of the Batangas mandarin orange, treated with various disinfectants, and cured and stored in an underground, ventilated chamber*—Continued

Treatment of fruit	Fruit decayed													
	Fifth week		Sixth week		Seventh week		Eighth week		Ninth week		Tenth week		Eleventh week	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Check:														
No treatment	28	42.4	44	66.7	48	72.7	54	81.8	59	89.4	62	93.9	63	95.5
Do	15	18.8	25	31.3	37	46.8	47	58.8	52	65.0	57	71.3	65	81.3
Do	20	16.3	29	23.6	39	31.7	53	43.1	68	55.3	86	69.9	93	75.6
Do	29	19.3	39	26.0	53	35.3	76	50.7	88	58.7	99	66.0	114	76.0
Totals	92	22.0	137	32.7	177	42.2	230	54.9	267	63.7	304	72.6	335	80.0
Formalin solution:														
0.2 per cent, 3 minutes	26	39.4	37	56.1	53	80.3	58	87.9	62	93.9	65	98.5	66	100.00
Do	11	13.8	24	30.0	40	50.0	48	60.0	56	70.0	60	75.0	63	78.8
Do	14	11.4	27	22.0	55	44.7	81	65.9	97	78.9	110	89.4	111	90.2
0.2 per cent, 5 minutes	30	20.0	51	34.0	61	40.7	71	47.3	82	54.7	87	58.0	93	62.0
Totals	81	19.4	139	33.1	209	49.9	258	61.6	297	70.9	322	76.9	333	79.5
Copper sulphate solution:														
0.018 per cent, 3 minutes	37	56.1	48	72.7	53	80.3	61	92.4	63	95.5	63	95.5	63	95.5
Do	14	17.5	20	25.0	35	43.8	47	58.8	57	71.3	63	78.8	69	86.3
Do	13	10.6	29	23.6	54	43.9	73	59.4	82	66.7	105	85.4	113	91.9
0.018 per cent, 5 minutes	37	24.7	48	32.0	61	40.7	73	48.7	80	53.3	95	63.3	100	66.7
Totals	101	24.1	146	34.8	203	48.5	254	60.6	282	67.3	326	77.8	345	82.3
Potassium permanganate solution:														
0.025 per cent, 5 minutes	15	16.7	30	33.3	43	47.8	58	64.4	64	71.1	77	85.6	80	88.9
0.05 per cent, 5 minutes	14	15.6	22	24.4	26	28.9	39	43.3	49	54.4	66	73.3	69	76.7
0.018 per cent, 5 minutes	29	19.3	33	22.0	47	31.3	65	43.3	79	52.7	89	59.3	95	63.3
Totals	58	17.6	85	25.8	116	35.2	162	49.1	192	58.2	232	70.3	244	73.9

After several weeks of storage, sound fruits under the same conditions and treatments exhibited varying qualities—some having improved greatly in flavor and eating quality, while others not; some remained juicy, while others became dry; and in some the skin assumed a silky and pliable condition, while in others it remained firm and rather brittle. It should be remarked that the fruits used in the experiments were obtained from seedling trees, and it is probable that this lack of uniformity was due to the variability inherent in the fruits of such trees.

Table II presents a comparison of the extent of decay in fruits picked in the ordinary way and in those harvested with a clipper. The figures show that at the end of the sixth and eleventh weeks, the average percentages of loss were 26.4 and 74.2 respectively, in the picked fruits, and 45.2 and 88.8 respectively, in the clipped fruits. These results agree with those already obtained in the previous experiments.

TABLE II.—*Showing the extent of decay in Batangas mandarin oranges picked by the ordinary way and by clipping.*

Clipped	Total No.	Fruits decayed—			
		Sixth week		Eleventh week	
		Number	Per cent	Number	Per cent
Not disinfected	80	25	31.3	65	81.3
Disinfected with formalin	80	24	30.0	63	78.8
Disinfected with copper sulphate	80	20	25.0	69	86.3
Not disinfected	66	44	66.7	63	95.5
Disinfected with formalin	66	37	56.1	66	100.0
Disinfected with copper sulphate	66	48	72.7	63	95.5
Averages	438	198	45.2	389	88.8
PICKED ORDINARY WAY					
Not disinfected	123	29	23.6	93	75.6
Disinfected with formalin	123	27	22.0	111	90.2
Disinfected with copper sulphate	123	29	23.6	113	91.9
Not disinfected	150	39	26.0	114	76.0
Disinfected with formalin	150	51	34.0	93	62.0
Disinfected with copper sulphate	150	48	32.0	100	66.7
Disinfected with potassium permanganate	150	33	22.0	95	63.3
Averages	969	256	26.4	719	74.2

A possible explanation for this fact is as follows: An examination of the decayed fruits revealed the fact that about 81 per cent of the loss was due to a decay which proceeded from the stem ends of the fruits. The organism causing the decay was probably located in the stem end region of the fruits and already present in a dormant state at the time of picking. When the stem is entirely removed from the fruit, as in the case when it is plucked off, the tissues in which the organism is lodged become hardened on exposure to the air, thus retarding or

entirely preventing the development of the organism. The tendency is for this organism to develop as the fruit becomes weaker and it is probable that this tendency is greater in clipped fruit having a portion of the stem attached than in fruit with the stem entirely removed. However, a further study is necessary before final statements can be made on this point.

The results obtained, thus far, in this work may be summarized as follows:

(1) That the ventilated type of underground storage chamber has given much better results than the unventilated type, in the storage and curing of mandarin oranges.

(2) That, under the conditions in which they were grown, fruits picked in the ordinary Batangas method kept better than clipped fruits.

(3) That disinfection of the fruit by immersing it for 5 minutes in 0.018 per cent solution of potassium permanganate before placing it in storage has markedly improved its keeping quality.

(4) That it is practicable to store mandarin oranges at least six weeks by using the ventilated type of storage chamber, at the same time greatly improving the appearance and eating quality of the fruit. However, it is believed that this period of time is not the limit of successful storage because many of the fruits remained in good condition even after the eleventh week of storage.

Year 1924.—In the previous experiments, the chambers used were constructed with earthen walls. In the present experiment a ventilated chamber with cement walls and ceiling was used. This chamber was constructed at a cost of about ₱350 and is capable of containing 6,000 oranges.

The fruits used were partly obtained from the Station orchard and partly from Balele, a distant barrio. They were picked carefully from the trees, in the ordinary way. The fruits from Balele were transported on horseback, over 10 kilometers of rough road, and they were considerably damaged.

The fruits were separated into three lots: Lot 1. Immersed for 5 minutes in 0.2 per cent formalin solution. Lot 2. Immersed for 5 minutes in 0.018 per cent potassium permanganate solution. Lot 3. Check, no treatment. Weekly observations were made until the 10th week. Some of the fruits in all of

these lots were kept in storage until the 14th week, when counts of decayed fruit were again made.

Discussion of Results.—Table III, gives a summary of the percentages of decayed fruits in these observations of the different lots. The Station fruits gave much better results than the Balele fruits which were injured while in transit. The percentage of decay in the Balele lots was about double that of the Station lots of fruits. After six weeks of storage, the Station fruit lost, through decay, 32.9 per cent in the formalin treated lot; 22.5 per cent in the potassium permanganate treated lot; and 22.7 per cent in the check lot. After the 10th week of storage, the loss of Station fruit was 82.4 per cent in the formalin treated lot; 74.1 per cent in the potassium permanganate treated lot; and 70.5 per cent in the check lot, while, after the 14th week of storage, the corresponding losses were 92.6 per cent, 83.5 per cent, and 83.1 per cent.

These percentages are averages of Station fruits picked January 7 and January 14, 1924. There is shown in these results a marked superiority in the keeping quality of the fruits picked later, and this is explainable only by the more careful picking and handling of the former. The results of this experiment confirm those of the previous experiments that formalin is a poor disinfectant for stored mandarin oranges. However, unlike the results of the previous experiment, the fruit disinfected with potassium permanganate did not show any superiority in its keeping quality over the untreated fruit.

Observations of the fruit in the course of the experiment showed that the orange color of the rind developed during the second week of storage. The eating quality of the fruit improved in the first few weeks and kept good until about the eighth week of storage when the fruit became drier and drier until too dry for eating.

Conclusions.—Better results were obtained in the storage of Batangas mandarin oranges with the use of the present cement underground chamber than with the former earthen chambers. The smallest per cent of decayed fruit, after six weeks of storage, was 22.5 per cent in the cement, and 25.8 per cent in the former earthen chamber, both in the potassium permanganate treated lots.

TABLE III.—*Weekly percentages of decay in fruits of the Batangas mandarin orange treated and untreated with disinfectants and placed in the cement underground chamber at Tanauan Citrus Station.*

Treatment of fruit	Origin and size of fruit	Date placed in storage	Number	Fruit decayed—							
				First week		Second week		Third week		Fourth week	
				Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Immersed for 5 minutes in 0.2 per cent formalin solution	Station 3 inches size	Jan 7, 1924	50	0	0	0	0	2	4.0	4	8.0
	Station $2\frac{3}{4}$ inches size	do	350	1	0.3	3	0.9	9	2.6	20	5.7
	do	Jan. 14, 1924	110	0	0	0	0	0	0	0	0
	Station $2\frac{1}{2}$ inches size	do	80	0	0	0	0	0	0	1	1.3
Totals			590	1	0.2	3	0.5	11	1.9	25	4.2
	Balele 3 inches size	Jan. 7, 1924	103	0	0	2	1.9	14	13.6	15	14.6
	Balele $2\frac{3}{4}$ inches size	do	315	6	1.9	45	14.3	75	23.8	118	37.5
Totals			418	6	1.4	47	11.3	89	21.3	133	31.8
Immersed for 5 minutes in 0.02 per cent potassium permanganate solution	Station 3 inches size	Jan. 7, 1924	50	1	2.0	1	2.0	1	2.0	1	2.0
	Station $2\frac{3}{4}$ inches size	do	350	0	0	4	1.1	8	2.2	19	5.4
	do	Jan. 14, 1924	110	0	0	0	0	0	0	1	0.9
	Station $2\frac{1}{2}$ inches size	do	80	0	0	1	1.3	1	1.3	1	1.3
Totals			590	1	0.2	6	1.2	10	1.7	22	3.7
	Balele 3 inches size	Jan. 7, 1924	103	0	0	11	10.6	24	23.3	37	35.9
	Balele $2\frac{3}{4}$ inches size	do	315	0	0	21	6.7	68	21.6	85	26.9
Totals			418	0	0	32	7.7	92	22.1	122	29.2
Check, the fruits were untreated	Station 3 inches size	Jan. 7, 1924	50	0	0	0	0	0	0	2	4.0
	Station $2\frac{3}{4}$ inches size	do	350	1	0.3	8	2.2	16	4.6	26	7.4
	do	Jan. 14, 1924	110	0	0	1	0.9	1	0.9	1	0.9
	Station $2\frac{1}{2}$ inches size	do	80	0	0	1	1.3	1	1.3	1	1.3
Totals			590	1	0.2	10	1.7	18	3.1	30	5.1
	Balele 3 inches size	Jan. 7, 1924	103	3	2.9	14	13.6	25	24.3	37	35.9
	Balele $2\frac{3}{4}$ inches size	do	315	2	0.6	33	10.5	60	19.0	82	26.3
Totals			418	5	1.2	47	11.2	85	20.3	119	28.4

Treatment of fruit	Fruit decayed—													
	Fifth week		Sixth week		Seventh week		Eighth week		Ninth week		Tenth week		Eleventh week	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Immersed for 5 minutes in 0.2 per cent formalin solution	8	16.0	13	26.0	27	54.0	32	62.0	41	82.0	41	82.0	(a)	(a)
	88	25.1	145	41.4	240	68.6	269	76.9	307	87.7	318	90.9	338	96.6
	4	3.6	22	20.0	32	29.1	52	47.3	68	61.8	71	64.5	89	80.9
	3	3.8	14	17.5	23	28.8	39	48.8	50	62.5	56	70.0	73	91.3
Totals	103	17.5	194	32.9	322	54.6	392	66.4	466	79.0	486	82.4	500	92.6
	37	35.9	60	58.3	82	79.6	91	88.3	98	95.1	101	98.1	(a)	(a)
	160	50.8	212	67.3	229	72.7	238	75.6	246	78.1	252	80.0	263	83.5
Totals	197	42.1	272	65.1	311	74.4	329	78.7	344	82.3	353	84.4	263	83.5
Immersed for 5 minutes in 0.02 per cent potassium permanganate solution	10	20.0	14	28.0	29	58.0	33	66.0	40	80.0	41	82.0	(a)	(a)
	45	12.9	95	27.1	167	47.7	187	53.4	249	71.1	273	78.0	317	90.6
	3	2.7	13	11.8	23	20.9	41	37.3	58	52.7	65	59.1	85	77.3
	1	1.3	11	13.8	13	16.3	36	45.0	48	60.0	58	72.5	70	87.5
Totals	59	10.0	133	22.5	232	39.3	297	50.3	395	66.9	437	74.1	472	87.4
	44	42.7	54	52.4	70	68.0	77	74.8	89	86.4	98	95.1	(a)	(a)
	128	40.6	188	59.7	227	72.1	242	76.8	258	81.9	282	89.5	298	94.6
Totals	172	41.1	242	57.8	297	71.1	319	76.3	347	83.0	380	90.9	298	94.6
Check the fruits were untreated	6	12.0	14	28.0	32	64.0	33	66.0	39	78.0	42	84.0	(a)	(a)
	46	13.1	98	28.0	186	53.1	211	60.3	254	72.6	278	79.3	306	87.4
	3	2.7	10	9.1	15	13.6	31	28.3	46	41.8	52	47.3	76	69.1
	2	2.5	12	15.0	17	21.3	26	32.5	34	42.5	44	55.0	67	83.7
Totals	57	9.5	134	22.7	250	42.4	301	51.0	373	63.2	416	70.5	449	83.1
	45	43.7	58	56.3	71	68.9	77	74.8	92	89.3	98	95.1	(a)	(a)
	127	40.8	166	52.7	213	67.6	234	74.3	251	79.7	262	83.1	283	89.8
Totals	172	41.1	224	53.6	284	67.9	311	74.4	343	82.0	360	86.1	283	89.8

[a] Discontinued.

Fruits carefully picked and handled gave lower percentages of decayed fruit than the foregoing figures. The check lot and the potassium permanganate treated lot, each containing 190 fruits, placed in storage on January 14, 1924, gave average losses of 16.8 per cent and 18.4 per cent respectively, after seven weeks of storage. On the other hand, fruits carefully handled, but packed in baskets and transported on horseback over rough roads, gave very poor storage results.

Year 1925.—In 1925, the objects of the experiment were: (*a*) to compare the storing qualities of untreated fruit with those of similar fruit immersed for 5 minutes in a 0.018 per cent potassium permanganate solution; (*b*) to determine the keeping qualities of "weak" fruit as compared with the normal fruit. "Weak" fruits are those produced by trees, which through exhaustion or other causes, are devitalized. Such fruits are easily detached from their stems, unlike the normal ones, which cling quite tightly to their stems, even though ripe.

The fruits used in the experiment were selected, and all of them were kept in the underground storage chamber of the station.

Table IV shows the loss of fruit, from the three lots of fruit, due to decay of all sorts, during the ten weeks of storage.

TABLE IV.—*Showing percentages of decayed fruits under different treatments*

Kind and treatment of fruit	Fruit decayed—					
	Number of fruits stored	Date placed in storage	First week		Second week	
			Number	Per cent	Number	Per cent
I. Normal fruit disinfected with 0.018 per cent potassium permanganate solution.	516	Jan. 17, 1925	0	0	1	0.2
	347	Jan. 24, 1925	1	0.3	3	0.9
	369	Jan. 31, 1925	1	0.3	7	1.9
	573	Jan. 10, 1925	0	0	1	0.2
Totals	1,805		2	0.1	12	.07
II. Normal fruit not treated	508	Jan. 17, 1925	0	0	6	1.2
	347	Jan. 24, 1925	0	0	1	0.3
	370	Jan. 31, 1925	0	0	2	0.5
	573	Jan. 10, 1925	0	0	10	1.7
Totals	1,798		0	0	19	1.1
Same as II but has no corresponding disinfected lot	540	Feb. 7, 1925	3	0.5	6	1.1
III. "Weak" fruit, disinfected with 0.018 per cent potassium permanganate solution.	43	Jan. 10, 1925	0	0	4	9.3
	21	Jan. 24, 1925	0	0	5	23.8
Totals	64		0	0	9	14.1

TABLE IV.—*Showing percentages of decayed fruits under different treatments*—Continued

Kind and treatment of fruit	Fruit decayed—							
	Third week		Fourth week		Fifth week		Sixth week	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
I. Normal fruit disinfected with 0.018 per cent potassium permanganate solution.	9 19 12 8	1.7 5.5 3.3 1.4	61 34 12 62	11.8 9.8 3.3 18.2	88 65 23 187	17.1 18.7 6.2 32.6	231 111 54 263	44.8 32.0 14.6 45.9
Totals......	48	2.7	169	9.3	363	20.1	659	36.5
II. Normal fruit not treated.	26 11 6 25	5.1 3.2 1.6 4.4	74 32 17 66	14.6 9.2 4.6 11.5	118 60 38 153	23.2 17.3 10.3 26.7	227 109 80 206	44.7 31.4 21.6 36.0
Totals......	68	3.8	189	10.5	369	20.5	622	34.6
Same as II but has no corresponding disinfected lot.	12	2.2	20	3.7	60	11.1	95	17.6
III. "Weak" fruit, disinfected with 0.018 per cent potassium permanganate solution.	5 6	11.6 28.6	19 7	44.2 33.3	24 12	55.8 57.1	32 13	74.4 61.9
Totals......	11	17.2	26	40.6	36	56.3	45	70.3

Kind and treatment of fruit	Fruit decayed—							
	Seventh week		Eighth week		Ninth week		Tenth week	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
I. Normal fruit disinfected with 0.018 per cent potassium permanganate solution.	284 176 98 364	55.0 50.7 26.6 63.5	358 219 145 410	69.4 63.1 39.3 71.6	408 261 204 464	79.1 78.1 55.3 81.0	438 281 237 485	83.3 81.0 64.2 84.6
Totals......	922	51.1	1132	62.7	1337	74.1	1441	79.8
II. Normal fruit not treated.	286 169 133 300	56.3 48.7 35.9 52.4	357 197 181 341	70.3 56.7 48.9 59.5	393 234 226 395	77.4 67.4 61.1 68.9	421 253 257 426	82.9 72.9 69.5 74.3
Totals......	888	49.4	1076	59.8	1248	69.4	1357	75.5
Same as II but has no corresponding disinfected lot.	130	24.1	198	36.7	253	46.9	307	56.9
III. "Weak" fruit, disinfected with 0.018 per cent potassium permanganate solution.	36 13	83.7 61.9	37 17	86.0 81.0	38 20	88.4 96.2	42 20	97.7 96.2
Totals......	49	76.6	54	84.4	58	90.6	62	96.9

Discussion of results.—The results of these storage experiments showed that untreated fruit kept about as well as the fruit disinfected with potassium permanganate, during the first five weeks of storage; and that during the second five weeks of storage, the untreated fruit stored decidedly better than the disinfected fruit.

The "weak" fruit had much poorer keeping qualities than the normal fruit.

In general, the results of the storage of mandarin oranges this year were not so good as in previous years. This was probably due to the presence of stem end rot among the stored fruits.

There were only two lots of fruit which kept very well during the storage experiment. In Group I, the lot stored on January 31, 1925, showed percentage losses, after the fifth and successive weeks of storage, of only, 6.2, 14.6, 26.6, 39.3, 55.3, and 64.2. An untreated lot, Group II, stored on February 7, 1925, showed percentage losses, after the fifth and successive weeks of storage, of only 11.1, 17.6, 24.1, 36.7, 46.9, and 56.9.

COVER CROP, FERTILIZER, AND TOP-WORKING EXPERIMENTS WITH MANDARIN TREES AT THE TANAUAN CITRUS EXPERIMENT STATION FROM 1923 to 1927

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CONTINUOUS COVER CROP VS. TILLAGE-COVER CROP FOR BATANGAS MANDARIN TREES

One of the most important experiments which has been carried on since 1923 has been to determine which cultural practice would best suit the Batangas mandarin orchard.

Table 1 shows the average yields of trees, annually, and for the five-year period 1923–1927, in plots under different cultural treatments and cover crops. The average health conditions of the trees are also shown in this table, expressed numerically as follows: 1 stands for very poor, 2 for poor, 3 for fair, 4 for good, and 5 for very good condition.

Year	*Tephrosia*—no tillage Block A, average of 23 trees		Tillage—cover crop Block A, average of 18 trees		Cacahuate—no tillage Block A, average of 22 trees		Patani—no tillage Block B, average of 37 trees		Tillage—cover crop Block B, average of 114 trees		Cacahuate—no tillage Block B, average of 47 trees	
	Yield in fruits	Condition	Yield in fruits	Condition	Yield in fruits	Condition	Yield in fruits	Condition	Yield in fruits	Condition	Yield in fruits	Condition
1923	0	3	0	3	0	3	20.2	3	21.1	3	55.4	3
1924	11.0	3.4	6.6	2.9	10.1	3.1	31.8	4.4	29.7	3.5	45.0	3.8
1925	7.8	4.5	5.4	2.6	0.8	2.8	17.1	4.1	6.8	2.9	12.1	4.4
1926	75.0	4.1	12.9	2.1	20.9	2.7	59.5	3.8	40.2	3.5	351.8	4.5
1927	237.0	4.9	33.1	3.3	77.0	3.8	58.8	4.0	30.5	3.9	94.3	4.8
Average of 5 years	66.2	4.0	11.6	2.8	21.8	3.1	37.5	3.9	25.7	3.4	111.8	4.1

Discussion of results.—It is shown in the foregoing table that in Block A, with a poor soil at the start of the experiment, the trees with continuous cover crops of *Tephrosia* and cacahuate, were better off, both in yields and condition, than those under tillage and temporary cover crops. Of the two legumes used

for continuous cover cropping in this block, the *Tephrosia* benefited the trees more than the cacahuate did.

In Block B, with a fairly good soil at the start of the experiment, continuous cover cropping with legumes again proved more beneficial to the trees than did tillage and temporary cover cropping. The continuous cover crop of cacahuate proved to be better than the patani.

THE EFFECT OF CONTINUOUS LEGUMINOUS COVER CROPS ON THE NITROGEN CONTENT OF BATANGAS MANDARIN ORCHARD SOILS

That the soil is greatly benefited by growing on it continuous leguminous cover crops has been evident from the favorable response which mandarin trees have shown when such cover crops are present. Chemical analyses of Batangas mandarin soils in this station, previous to and after planting cover crops, have shown tremendous increases in the nitrogen content of the soil due to the use of the legumes.

Before planting the leguminous cover crops, in February 1923, soil samples from different plots were submitted for chemical analysis at the Bureau of Science. In September 1927, soil samples from the same plots, after having had the cover crops for from 1.5 to 4 years, were again submitted for analysis. The precaution was taken not to get the latter samples where commercial fertilizers might have affected their composition.

Table 2 gives the percentages of nitrogen in these soils, previous to and after having the cover crops. This table also shows the computed increases in the quantities of nitrogen, which may be ascribed to the enriching effect of the legumes. In this computation, it was supposed that about 6.5 inches of the surface soil was affected, and the weight of this soil is estimated at 2,000,000 kilos per hectare.

Discussion of results.—The table shows the tremendous soil enriching properties of leguminous cover crops. From 420 to 1,480 kilos of nitrogen per hectare have been added. Without any other advantage than that of adding nitrogen to the soil a hectare of leguminous cover crop would become worth from ₱252 to ₱888 to the soil, in from 1.5 to 4 years, by adding from 420 to 1,480 kilos of nitrogen, valued at ₱0.60 a kilo. The value of a cover crop, however, is not only due to its ability to add nitrogen to the soil. It also furnishes humus, which benefits the soil in many important ways.

TABLE 2.—*Nitrogen content of Batangas mandarin orchard soils previous to and after having had continuous leguminous cover crops*

Plot and kind of cover crop	Duration experiment	N content previous to cover cropping	N content after having had cover crop	Increase in N content	Computed quantity of N added per hectare
	Years	*Per cent*	*Per cent*	*Per cent*	*Kilos*
Block A. *Tephrosia candida*	4	0.058	0.129	0.071	1,420
Block A. Cacahuate	3	0.074	0.148	0.074	1,480
Block B.–east. Patani	4	0.070	0.119	0.049	980
Block B.–east. Cacahuate	4	0.072	0.128	0.056	1,120
Block G. Ipil-ipil	3	0.056	0.107	0.051	1,020
New M. O. Ipil-ipil	3	0.070	0.135	0.065	1,300
New M. O. *Tephrosia*	1:5	0.062	0.128	0.066	1,320
New M. O. *Tephrosia*	3	0.070	0.114	0.044	880
V. C. O. Ipil-ipil	3	0.083	0.104	0.021	420

FERTILIZER EXPERIMENT NO. 8, BLOCK G.

This experiment was started in November 1924. The ground was plowed and prepared, and ipil-ipil was planted for a continuous cover crop. The Batangas mandarin trees were about 19 years old, but were then fast degenerating on account of the incursion of the *Loranthus* parasite, and the insufficient care given them by the former owner of the grove. The soil in this block is alluvial and therefore rich.

Plot 1 (trees No. 1–5). For each tree 0.48 kilo nitrogen, 0.32 kilo phosphoric acid, and 0.24 kilo potash per year, in the form of copra meal, superphosphate and ammonium sulphate.

Plot 2 (trees No. 6–10). For each tree 0.48 kilo nitrogen and 0.32 kilo phosphoric acid per year, in the form of bat guano and nitrate of soda.

Plot 3 (trees No. 11–15). For each tree 0.48 kilo nitrogen and 0.24 kilo potash per year, in the form of ammonium sulphate and H. G. sulphate of potash.

Plot 4 (trees No. 16–20). For each tree 0.23 kilo phosphoric acid and 0.24 kilo potash per year, in the form of superphosphate and H. G. sulphate of potash.

Plot 5 (trees No. 21–25). For each tree 0.48 kilo nitrogen, 0.32 kilo phosphoric acid, and 0.24 kilo potash, plus 0.5 kilo ferrous sulphate, in the form of copra meal, superphosphate, and ammonium sulphate per year.

Plot 6 (trees No. 26–30). Check trees. No fertilizers given.

Plot 7 (trees No. 31–33). For each tree 3 kilos lime and 0.6 kilo sulphur per year.

Plot 8 (trees No. 34–36). For each tree 3 kilos of lime per year.

The progress of this experiment from 1924 to 1927 is shown in Table 3.

TABLE 3.—*Average annual yields and condition of trees in Fertilizer Experiment No. 8*

Plot number and treatment	1924		1925		1926		1927	
	Yield in fruits	Condition	Yield in fruits	Condition	Yield in fruits	Condition	Yield in fruits	Condition
1. N-P-K. Copra meal, superphosphate and ammonium sulphate	40.0	3.4	11.8	2.8	72.0	4.0	395.4	4.4
2. N-P. Bat guano and nitrate of soda	123.4	3.2	20.4	1.4	111.2	3.6	1,043.0	4.6
3. N-K. Ammonium sulphate and H. G. sulphate of potash	114.0	3.4	15.4	2.6	171.6	4.8	903.8	5.0
4. P-K. Superphosphate and H. G. sulphate of potash	125.2	3.6	6.8	1.6	0.6	3.6	566.8	4.8
5. N-P-K-Fe. Copra meal, superphosphate, ammonium sulphate, and ferrous sulphate	85.4	3.6	1.2	4.0	99.4	4.2	413.2	5.0
6. Check trees	17.6	4.0	0	2.0	2.2	3.0	151.8	4.8
7. Lime, sulphur	628.3	3.0	0	2.0	46.3	3.3	413.3	3.7
8. Lime only	224.3	3.0	0.7	2.0	29.3	2.3	4.7	3.7

The lime was applied once in October and the fertilizers twice—in May and November.

Discussion of results.—The progress of this experiment showed the following results:

1. The trees were poor at the beginning of the second year of the experiment probably because of the unfavorable effect of the tillage incident to the planting of the cover crop the previous year. Furthermore, the cover crop and the fertilizers had not had enough time to make their presence felt.

2. The trees receiving nitrogen either in a complete or incomplete mixture generally gave the best yields and were in the best condition in the third and fourth years of the experiment.

3. The supplemental application of ferrous sulphate to a complete fertilizer was of doubtful value.

4. Lime alone was detrimental to the trees.

5. The check trees also improved considerably due probably to the beneficial effect of the cover crop although they were far from improving as rapidly as those receiving nitrogen and other fertilizers.

FERTILIZER AND COVER CROP EXPERIMENT NO. 3

This experiment was begun in 1924. The trees selected for this experiment were quite uniform. They were separated into 8 lots, treated as follows:

1. Trees No. A5, A11, A17. Continuous cover crop of *Tephrosia candida.*

2. Trees No. A6, A12, A16. Same cultural treatment.

3. Trees No. A26, A29, A32, and A40. Tillage and temporary cover crop.

4. Trees No. A30, A33, A50. Same cultural treatment.
5. Trees No. A56, A70, A78. Continuous cover crop of cacahuate.
6. Trees No. A63, A77, A86. Same cultural treatment.
7. Trees No. A1 and A2. Check trees for lots 1 and 2.
8. Tree No. A39. Check tree for lots 3 and 4.
9. Trees No. A72 and A88. Check trees for lots 5 and 6.

All the trees except the check trees were given a complete fertilizer composed of horse manure and superphosphate and containing 0.6 kilo nitrogen, 0.56 kilo phosphoric acid, and 0.48 kilo potash. The trees in lots 1, 3, and 5, received in addition to the above-named fertilizer, 0.9 kilo sulphur. The amounts just stated were for one tree, per year. The fertilizer was given in two applications and the sulphur in only one application per year. Table 4 shows the average annual yields and condition of trees in the different lots in the period from 1924 to 1927.

TABLE 4.—*Average annual yields and condition of trees, 1924–1927. Fertilizer and Cover Crop Experiment No. 3. Block A*

Lot number and cultural treatments	Year	Number of trees	Yield in number of fruits		Health condition	
			Total	Average	Total	Average
1. Continuous cover crop of *Tephrosia candida*	1924	3	40	13.3	10	3.3
	1925	3	14	4.7	15	5.0
	1926	3	307	102.3	14	4.7
	1927	3	517	172.3	15	5.0
2. Continuous cover crop of *Tephrosia candida*	1924	3	5	1.7	10	3.3
	1925	3	56	18.7	14	4.7
	1926	3	407	139.0	13	4.3
	1927	3	959	319.7	14	4.7
3. Tillage and temporary cover crop	1924	4	110	27.5	11	2.8
	1925	4	30	7.5	11	2.8
	1926	4	41	10.3	8	2.0
	1927	4	197	49.3	12	3.0
4. Tillage and temporary cover crop	1924	3	0	0	9	3.0
	1925	3	17	5.7	10	3.3
	1926	3	64	21.3	6	2.0
	1927	3	121	40.3	10	3.3
5. Continuous cover crop of cacahuate	1924	3	32	10.7	12	4.0
	1925	3	26	8.7	12	4.0
	1926	3	640	213.3	14	4.7
	1927	3	531	177.0	14	4.7
6. Continuous cover crop of cacahuate	1924	3	130	43.3	11	3.7
	1925	3	0	0	11	3.7
	1926	3	325	108.3	15	5.0
	1927	3	224	74.7	14	4.7
7. Check trees for lots 1 and 2	1924	2	42	21.0	8	4.0
	1925	2	46	23.0	7	3.5
	1926	2	10	5.0	6	3.0
	1927	2	604	302.0	10	5.0
8. Check trees for lots 3 and 4	1924	1	1	1.0	3	3.0
	1925	1	0	0	2	2.0
	1926	1	0	0	1	1.0
	1927	0	(a)	......	......	......
9. Check trees for lots 5 and 6	1924	2	5	2.5	6	3.0
	1925	2	0	0	5	2.5
	1926	2	50	25.0	4	2.0
	1927	2	89	44.5	8	4.0

[a] Dead.

Discussion of results.—The foregoing table shows the following results:

1. The trees with continuous cover crops continued to improve much faster than those under tillage and temporary cover crops.
2. The unfertilized check lot with *Tephrosia* cover crop made a better average yield in 1927 than any other lot except lot 2, which had *Tephrosia* and a complete fertilizer.
3. Sulphur did no good to the trees to which it was applied.

FERTILIZER, LIME AND COVER CROP EXPERIMENT NO. 7

This experiment was started in January 1925, to determine the value of nitrogen alone, and of complete fertilizers supplemented with lime, on the improvement of Batangas mandarin trees.

The main plan of this experiment can best be understood by examining Table 5 which also shows the yields and condition of the trees in 1927.

Discussion of results—

1. As in 1926, ammonium sulphate again proved to be a much better source of nitrogen than copra meal. The average yield for all the trees receiving ammonium sulphate was 166.0 fruits per tree, while the average yield for all the trees receiving copra meal was only 30.1 fruits per tree. The average health condition for the former trees was 4.7, or almost very good, while that for the latter was only 4.2, or slightly better than good.
2. The largest amount of nitrogen given each tree per year in the ammonium sulphate lots, was 0.5 kilo. The average yields for trees receiving 0.25, 0.5 and 0.75 kilo of nitrogen per tree were 173.6, 259.2 and 65.3 fruits, respectively. In the copra meal lots slightly better yields were produced by the trees receiving 0.75 kilo of nitrogen per tree. The average yields for trees receiving 0.25, 0.5, and 0.75 kilo of nitrogen per tree, were 12.1, 35.1 and 43.1 fruits, respectively.
3. The application of phosphoric acid and potash in addition to ammonium sulphate again slightly increased the yields of trees as compared with those made by trees receiving only ammonium sulphate. In the copra meal lots, however, the additional phosphoric acid and potash slightly lowered the yields.

The results of the experiment for the year 1926 can be seen in Table 6.

TABLE 5.—*Showing the plan of the experiment, the individual and the average yields and health conditions of trees under different fertilizer treatments, 1927*

	2.5 K. lime every 2 years			5.0 K. lime every 2 years			5 K. lime every 2 years + 0.48 K. P_2O_5 + 0.24 K. K_2O			Averages	
	Tree No.	Yield	Condition	Tree No.	Yield	Condition	Tree No.	Yield	Condition	Yield	Condition
0.25 K. N per tree per year in the form of 1.25 K. ammonium sulphate.	A 4	68.0	5	A 19	36.0	5	A 20	463.0	5	173.6	4.9
	B 278	225.0	5	B 277	12.0	5	B 257	51.0	4		
	B 134	281.0	5	B 135	24.0	5	B 157	402.0	5		
Averages	....	191.3	5	....	24.0	5	....	305.3	4.7		
0.5 K. N per tree per year in the form of 2.5 K. ammonium sulphate.	A 21	33.0	5	A 23	341.0	5	A 24	609.0	5	259.2	5.0
	B 282	78.0	5	B 280	10.0	5	B 279	327.0	5		
	B 158	554.0	5	B 212	381.0	5	B 213	0.0	5		
Averages	....	221.7	5	....	244.0	5	....	312.0	5		
0.75 K. N per tree per year in the form of 3.75 K. ammonium sulphate.	A 27	151.0	4	A 28	43.0	5	A 31	23.0	4	65.3	4.4
	B 304	94.0	4	B 303	160.0	5	B 301	30.0	5		
	B 214	28.0	5	B 253	53.0	5	B 293	6.0	3		
Averages	....	91.0	4.3	....	85.3	5	....	19.7	4		
Vertical averages for ammonium sulphate plots	....	168.0	4.8	....	117.8	5.0	....	212.3	4.6		
0.25 K. N per tree per year in the form of 10 K. of copra meal.	A 34	0	4	A 35	4.0	3	A 41	10.0	3	12.1	4.3
	B 247	5.0	5	B 244	2.0	5	B 242	0	5		
	B 68	75.0	4	B 69	0	5	B 93	13.0	5		
Averages	....	23.3	4.3	....	2.0	4.3	....	7.3	4.3		
0.5 K. N per tree per year in the form of 20 K. copra meal	A 42	2	3	A 46	12.0	3	A 47	0	3	35.1	4.1
	B 232	106.0	4	B 227	27.0	5	B 225	48.0	5		
	B 94	14.0	5	B 113	92.0	5	B 115	15.0	4		
Averages	....	40.7	4	....	43.7	4.3	....	21.0	4		
0.75 K. N per tree per year in the form of 30 K. copra meal	A 48	0	3	A 36	0	4	A 37	36.0	4	43.1	4.2
	B 300	112.0	5	B 299	40.0	5	B 298	82.0	5		
	B 116	117.0	5	B 117	1.0	5	B 45	0	2		
Averages	....	76.3	4.3	....	13.7	4.7	....	39.3	3.7		
Vertical averages for copra meal lots	....	47.9	4.2	....	19.8	4.4	....	22.7	4.0		

TABLE 6.—*Showing the plan of the experiment, the individual and the average yields and health conditions of trees under different fertilizer treatments, 1926*

	2.5 K. lime every 2 years			5.0 K. lime every 2 years			5 K. lime every 2 years + 0.48 K. P_2O_5 + 0.24 K. K_2O			Averages	
	Tree No.	Yield	Health condition	Tree No.	Yield	Health condition	Tree No.	Yield	Health condition	Yield	Health condition
0.25 K. N per tree per year in the form of 1.25 K. ammonium sulphate.	A 4 B 278 B 134	8 190 514	4 5 5	A 19 B 277 B 135	3 40 1,834	4 5 5	A 20 B 257 B 157	30 180 675	5 4 5	386.0	4.7
Averages	....	237.3	4.7	....	625.7	4.7	....	295	4.7		
0.5 K. N per tree per year in the form of 2.5 K. ammonium sulphate.	A 21 B 282 B 158	9 181 1,026	4 5 4	A 23 B 280 B 212	137 85 546	5 5 5	A 24 B 279 B 213	140 150 1,614	4 5 5	432.0	4.7
Averages	....	405.3	4.3	....	256	5	....	668	4.7		
0.75 K. N per tree per year in the form of 3.75 K. ammonium sulphate.	A 27 B 304 B 214	64 250 640	3 5 5	A 28 B 303 B 253	0 40 15	2 5 5	A 31 B 301 B 293	51 0 320	3 5 4	153.3	4.1
Averages	....	318	4.3	....	18.3	4	....	123.7	4		
Vertical averages for ammonium sulphate plots	....	320.2	4.4	....	300	4.6	....	351.1	4.4		
0.25 K. N per tree per year in the form of 10 K. copra meal	A 34 B 247 B 68	0 180 10	1 4 5	A 35 B 244 B 69	0 37 9	2 5 3	A 41 B 242 B 93	0 0 10	2 5 5	27.3	3.6
Averages	....	63.3	3.3	....	15.3	3.3	....	3.3	4		
0.5 K. N per tree per year in the form of 20 K. copra meal	A 42 B 232 B 94	0 284 100	3 4 5	A 46 B 227 B 113	0 3 413	2 5 5	A 47 B 225 B 115	0 3 84	2 3 5	98.6	3.8
Averages	....	128	4	....	138.7	4	....	29	3.3		
0.75 K. N per tree per year in the form of 30 K. copra meal	A 48 B 300 B 116	0 50 190	2 5 2	A 36 B 299 B 117	0 45 6	2 5 3	A 37 B 298 B 45	0 150 25	3 5 3	51.7	3.3
Averages	....	80	3	....	17	3.3	....	58.3	3.7		
Vertical averages for copra meal lots	....	90.4	3.4	....	57.0	3.6	....	30.2	3.7		

THE EFFECTS OF COVER CROPS ON TREES UNDER FERTILIZER EXPERIMENT NO. 7

To show the comparative values of tillage-cover crop and no tillage-continuous cover crop, combined with the use of lime and fertilizers, on the improvement of Batangas mandarin trees, Table 7 was made. All the trees included in Experiment No. 7 were grouped under the following cultural treatments:

1. Continuous cover crop of patani. No tillage except hoeing near the tree bases.
2. Continuous cover crop of *Tephrosia*. No tillage. Occasional cutting of cover crop growth and mulching the tree bases.
3. Continuous cover crop of cacahuate. No tillage. Occasional cutting of cover crop growth and mulching of the tree bases.
4. Tillage and cover crop. The ground was broken twice in a year and 1 or 2 temporary cover crops grown in the grove.
5. Light tillage and cover crop. The ground was broken lightly and a cover crop grown for about 6 months.

Discussion of results.—Table 7 gives the yields and conditions of the trees under Fertilizer Experiment No. 7, from 1925 to 1927. This table shows the following results:

1. A rapid improvement in the yield and condition of trees resulted from the combined use of a continuous cover crop of *Tephrosia* or of cacahuate and fertilizer. The yields and condition of trees for 1927, under these two leguminous cover crops were 258.3 fruits and 5 units, and 192.1 fruits and 4.8 units, respectively.
2. Patani used for continuous cover cropping made a poor showing.
3. Light tillage with a temporary leguminous cover crop in combination with the use of fertilizers proved only a fair system.
4. Tillage (ordinary depths) with temporary cover crops in combination with the use of fertilizers failed to improve the yield and conditions of the Batangas mandarin trees.

TOP-WORKING BATANGAS MANDARIN TREES

This work, which began in 1920, has established the fact that poor Batangas mandarin trees are easily top-worked because of their strong inclination to produce sprouts which are readily budded. Furthermore, as a stock the Batangas mandarin is of general adaptability.

TABLE 7.—*Yields and health conditions of trees grown under different kinds of cover crops, Fertilizer Experiment No. 7, 1925 to 1927*

Cover crop and cultural treatment	Year	Number of trees	Yields in number of fruits		Health conditions	
			Total	Average	Total	Average
1. Continuous cover crop of patani	1925	9	247	27.4	39	4.3
	1926	9	847	94.1	36	4.0
	1927	9	327	36.3	40	4.4
2. Continuous cover crop of *Tephrosia*	1925	6	27	4.5	25	4.2
	1926	6	327	54.5	26	4.3
	1927	6	1,550	258.3	30	5.0
3. Continuous cover crop of cacahuate	1925	9	286	31.8	42	4.7
	1926	9	7,184	798.2	43	4.8
	1927	9	1,729	192.1	43	4.8
4. Tillage and temporary cover crop	1925	12	49	4.1	25	2.1
	1926	12	115	9.8	27	2.3
	1927	12	281	23.4	43	3.9
5. Light tillage and temporary cover crop	1925	18	90	5.0	69	3.8
	1926	18	1,863	103.8	85	4.7
	1927	18	1,409	78.3	87	4.8

The test of varieties for top-working the mandarin carried on extensively since 1923, has shown, so far, that the following citrus varieties are best suited for this purpose, because of their commercial value, good bearing habits, and vigor:

Mandarin oranges: Selected Batangas, King, Kishiu and Szinkum.

Sweet oranges: Bahia; Balanga; Cajel, P. I. 966; Dougat; Homosassa; Majorca; Orange, P. I. 8868; Native No. 7; Native No. 8; Native No. 9; St. Micheal; Seville.

Pummeloes: Siamese S., P. I. 3442; Siamese S. P., P. I. 3673.

Miscellaneous citrus: Sampson tangelo, P. I. 1618; Calamondin; Carabao lime.

THE MAGUEY INDUSTRY OF ILOCOS NORTE

By Leoncio Dario
Agricultural Extension Agent

PREPARATION OF LAND

The greater part of the work of raising maguey is clearing the land. Usually it is covered with second-growth forest. Cutting down the trees, shrubs and other bushes, and piling and burning them is the first task. This condition obtains in the region between the municipality of Pasuquin and Burgos, and in a certain section of Bangui. In other places, especially along the sandy coast from the southern part of Pasuquin to Badoc, there is practically no clearing done except furrowing. No plowing is done preparatory to planting. In certain isolated rocky, hilly places, on the coastal section of Currimao, the removal of stumps of second-growth forest is also necessary.

In preparing one hectare of land preparatory to planting maguey, the procedure and expenditure are as follows:

1. Cutting down few second-growth trees but leaving roots and stumps in the ground, piling and burning them.

Expense.—One man working 10 hours a day at ₱1 per day without meals or ₱0.60 per day plus two meals, finishing the work in about 11 days, ₱11.

2. Clearing fairly thick bushes and second-growth forest trees, digging and removing roots and stumps, piling and burning them.

Expense.—Ten men of different working efficiency working ten hours a day at ₱0.60 per day without meals finishing the work in 41½ days, ₱249.

3. When the owner of the land with second-growth forest leases it to some one to clear by means of "caiñgin" to plant to upland palay or other crops for a year, the worker gets all the crop without giving any share to the owner. The next year the owner gets the cleared land and plants it to maguey. There is no actual outlay. But if the share of the owner of the land were to be paid in cash the owner would have spent for the clearing:

(*a*) Value of 4 uyones of palay at ₱15 per uyon	₱60.00
(*b*) Value of miscellaneous field crops	15.00
Total	75.00

4. Furrowing sandy or clay maguey land, without any or with only a few bushes.

(*a*) One man with plow and carabao working ½ day or 5 hours to finish the work	₱0.75

PLANTING

Planting maguey is done by drilling in hills, in rocky soils and on land with stumps and roots left standing; and, by placing

in furrows in clay and sandy soils. Suckers which are used for planting are generally 40 to 60 centimeters tall. Spacing varies greatly in different sections. In the northern section of the province, the spacing is 1 by 1 meter, 1 by 1.2 meters, and 1.2 by 1.2 meters; in the southern section of the province, it is 60 by 40 centimeters, 60 by 60 centimeters, 80 by 50 centimeters, 80 by 80 centimeters, 1 meter by 50 centimeters, 1 meter by 60 centimeters, 1 meter by 80 centimeters, and 1 by 1 meter. In general spacing in the northern section of the province is 1 by 1 meter and that in the southern section is 80 by 50 centimeters. Most of the old maguey fields are now overcrowded with unremoved suckers growing between the rows so that the original plan of spacing can no longer be recognized. It is claimed by those that practise close spacing that the plants protect each other from the ravages of stray animals and from being broken by strong winds.

Inasmuch as the expense of planting is generally based on the number of suckers planted, spacing is an important consideration. For purposes of the following computation, only the most common spacings practised, 1 by 1 meter and 80 by 50 centimeters, are considered.

For planting one hectare of land to maguey the expenses are as follows:

1. By administration, daily labor and wages.

(*a*) With 1 by 1 meter spacing:

Items	Cost per systen of planting	
	Drilled in hills	Furrowed on sandy or clay soil
For cost of 10,000 suckers at ₱3 per 1,000	₱30.00	₱30.00
For wages in gathering 10,000 suckers, 2 men working 6 days at ₱.60 plus two meals or ₱1 without meals per day each	12.00	12.00
For hauling 10,000 suckers, 1 man with cart and carabao working 2 days at ₱1.50 per day	3.00	3.00
For planting 10,000 suckers, 2 men at ₱1 per day each,—5 days' work by furrowing and 12 days by drilling	24.00	10.00
Total	69.00	55.00

(*b*) With 80 by 50 centimeters spacing:

For cost of 25,000 suckers at ₱3 per 1,000	₱75.00	₱75.00
For wages in gathering 25,000 suckers, 2 men working 15 days at ₱1 per day each	30.00	30.00
For hauling 25,000 suckers, 1 man with carabao and cart working 5 days at ₱1.50 per day	7.50	7.50
For planting 25,000 suckers, 2 men working 30 days by drilling in hills and 12.5 days by furrowing at ₱1 per day each	60.00	25.00
Total	172.50	137.50

2. By contract, paid in cash.

(*a*) With 1 by 1 meter spacing:

For cost of 10,000 suckers at ₱3 per 1,000	₱30.00	₱30.00
For gathering 10,000 suckers at ₱2 per 1,000	20.00	20.00
For hauling 10,000 suckers at ₱2 per 1,000	20.00	20.00
For planting 10,000 suckers at ₱3 per 1,000—by drilling in hills and ₱1 per 1,000 by furrowing	30.00	10.00
Total	100.00	80.00

(*b*) With 80 by 50 centimeters spacing:

For cost of 25,000 suckers at ₱3 per 1,000	₱75.00	₱75.00
For gathering 25,000 suckers at ₱2 per 1,000	50.00	50.00
For hauling 25,000 suckers at ₱2 per 1,000	50.00	50.00
For planting 25,000 suckers at ₱3 per 1,000 by drilling in hills and ₱1 per 1,000 by furrowing	75.00	75.00
Total	250.00	250.00

3. By contract, share basis.

(*a*) A laborer clears the land of the second-growth forest and plants it by drilling in hills with a spacing of 1 by 1 meter. The worker receives as compensation for his labor one-half of the maguey that may be raised yearly. In this particular case, the laborer invests only ₱80, which is the value of his labor. After three or four years the laborer will be getting from his share, one-half hectare planted to maguey, a yearly gross income of not less than ₱160 worth of fiber—20 piculs at ₱8 per picul. Considering three-fourths of the gross income as the highest possible expense for labor in preparing the fiber, the laborer would be making a yearly net income of ₱40 during a period of 20 years, or a net income of ₱800 in a period of 20 years of productivity.

(*b*) A laborer clears the land of the second-growth forest, plants it by drilling in hills, with a spacing of 1 by 1 meter. The worker harvests the crop without giving any share to the owner for a period of 5 years. After this period the owner takes over the whole plantation, that is, the laborer is given 5 years' crop as compensation. In this case the laborer invests only a capital of ₱80 which is the value of his labor. During the 5-year period the laborer would realize a total gross income of ₱1,600 estimating an average yield of 40 piculs clean fiber per hectare, at ₱8 per picul. Considering three-fourths of the product or its gross value as the highest probable cost of production, the laborer would be making a net income of ₱400. The owner in this particular case would be incurring a net loss of ₱400 minus ₱80 or ₱320.

In the absence of any other means of developing the land because the owner cannot work it himself or cannot afford the small amount of money to invest, the system of contract by the share basis is the best means to effect development.

CULTIVATION

Practically the plantation is not cultivated after planting. The only cultivation practised, in general, is the cutting down of shrubs and the removal of suckers that bother the harvesters at harvest time. This practice is resorted to only once a year and yet it is not done thoroughly because only those shrubs and suckers that happen to get in the harvesters' way are removed. Maguey plantation owners do not make any attempt to have their lands cleaned thoroughly of unnecessary trees and shrubs, and unnecessary overcrowding suckers even once a year. In plantations where the space between the rows could be cultivated by plow or other implements, this is not done either. As a result of this general local indifference, the plantations become overcrowded with suckers and other growths after 5 years, which is one of the causes of low yield.

HARVESTING AND RETTING

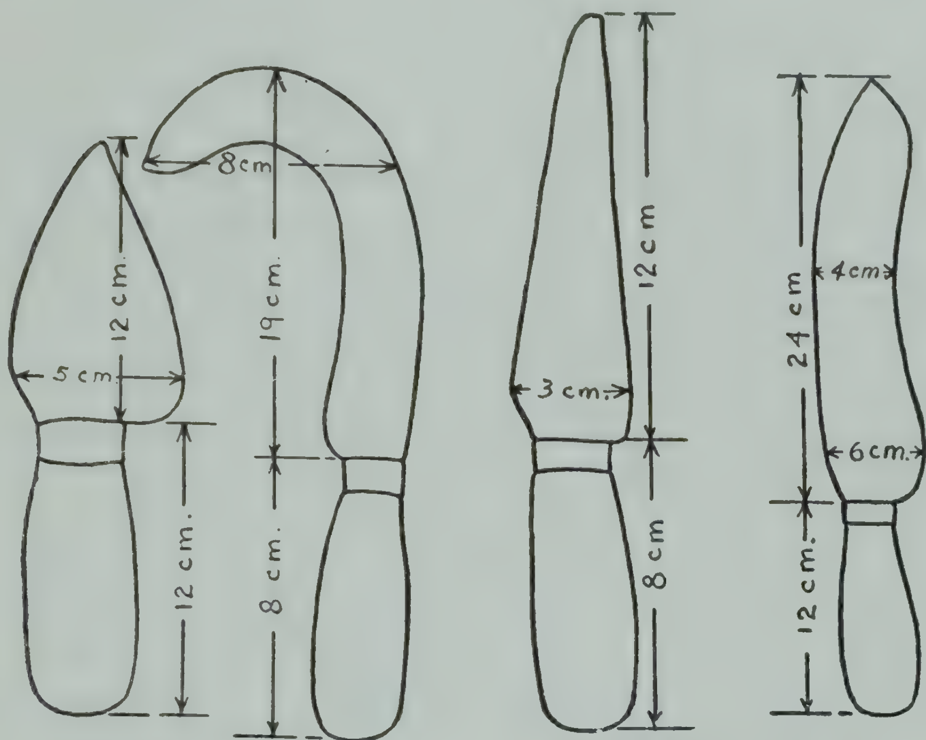
The harvesting and retting season generally extends from the close to the beginning of the rainy season, that is, from November to June of the following year. In places where they have a safe place for retting or where they have enough maguey leaves to work with during the rainy season, harvesting goes on throughout the year.

The general practice is to gather the leaves once a year. There are a few places though where harvesting is done once every two years. From ten to thirty-five leaves are cut from plants that are yearly cropped, and from thirty to eighty leaves from plants that are cropped every two years or more. Because of the scarcity of labor in the locality, there are places like Karoan, Nagsanga, Pasuquin and others where harvesting is done at three or more year intervals. From four to twelve leaves, generally six or eight excluding the young unopened bud, are left on each plant.

Tools made for the purpose are used in cutting and stripping the leaves. (See page 187.)

It is the practice of the majority of those that ret the leaves in salt water to split them into halves and also to cut off the butt end of the leaves halfway the tip. In a few cases the leaves are split into four sections. Those that ret in fresh water split the leaves into several pieces, 1 to 2 centimeters wide, with the aid of the special tools and with other ordinary tools. The process is very slow and the workers take more time to split the

same quantity of leaves to be retted in fresh water than in salt water.



For cutting leaves

For removing spines and for splitting leaves

It has been observed in several places that there are enough maguey leaves to harvest to provide the people continuous work for only two months. The laborers in some places are, however, unwilling to harvest maguey and as a result, in such places it is left unharvested for years. It has also been noted that some of the laborers engaged in the local maguey harvest are from the neighboring province of Ilocos Sur. They work on the contract, share basis.

Harvesting maguey is sometimes done by coöperative labor termed locally "ammuyo," where the owner provides the workers with two meals, and sometimes drinks and "buyo"; and, also, by contract the payment being made in cash or in kind. Harvesting by administration on the daily wage basis is never done. The principal unit bases in these contracts are the bundle of harvested leaves, cut, split and bundled for retting or for washing; and, the picul weight equivalent to 64 kilos, in case of already cleaned fiber. It must be noted that 64 kilos go to a picul instead of the standard 63 kilos only. The additional kilo is allowed for extra weight of bundling materials and moisture in the fiber. The size of the bundles of leaves that are ready for retting varies greatly according to usage in the dif-

ferent localities and according to the size of the leaves. The bundles are generally from 8 to 30 centimeters in diameter. The most common sizes are 10, 15, and 20 centimeters. The average size of the bundles is 16.75 centimeters in diameter. A picul of fiber can be produced from 118 bundles of this size made up of mixed sizes of leaves, that is, leaves from 60 centimeters long and 5 centimeters wide to 2 meters long 12 centimeters wide, mostly leaves 80 centimeters to 1.2 meters long and 6 to 10 centimeters wide. An average laborer can cut, split and bundle 29 bundles of maguey leaves for retting and wash and clean 65 bundles of retted maguey leaves 16.75 centimeters in diameter in a day.

The following shows the relative efficiency of workers:

1. Good worker:

(*a*) One man who cuts, splits, bundles 75 to 100 bundles of the 15- to 20-centimeter diameter or 120 to 200 bundles of the 8- to 12-centimeter diameter per day; and washes per day 100 to 150 bundles of the 15- to 20-centimeter or 150 to 225 bundles of the 8- to 12-centimeter diameter or cleans enough bundles to produce 1 to 2 piculs clean fiber.

(*b*) One woman who cuts, splits and bundles 50 to 70 bundles of the 15- to 20-centimeter diameter or 100 to 150 bundles of the 8- to 12-centimeter diameter per day; and washes 75 to 125 bundles of the 15- to 20-centimeter diameter or 125 to 175 bundles of the 8- to 12-centimeter diameter or enough to produce 50 kilos to 100 kilos clean fiber per day.

(*c*) One boy or girl who cuts, splits and bundles 35 to 50 bundles of the 15- to 20-centimeter diameter or 75 to 100 of the 8- to 12-centimeter diameter per day; and washes 50 to 60 bundles of the 15- to 20-centimeter diameter or 80 to 120 bundles of the 8- to 12-centimeter diameter or enough bundles to produce 30 to 64 kilos of clean fiber per day.

2. Fair worker:

(*a*) One man who cuts, splits and bundles 30 to 60 bundles of the 15- to 20-centimeter diameter or 80 to 120 bundles of the 8- to 12-centimeter diameter per day; and washes 75 to 100 bundles of the 15- to 20-centimeter diameter or 100 to 160 bundles of the 8- to 12-centimeter diameter or enough bundles to produce 75 to 90 kilos clean fiber per day.

(*b*) One woman who cuts, splits and bundles 20 to 40 bundles of the 15- to 20-centimeter diameter or 50 to 80 bundles of the 8- to 12-centimeter diameter per day; and washes 50 to 75 bundles of the 15- to 20-centimeter diameter or 80 to 100 bundles of the 8- to 12-centimeter diameter or enough bundles to produce 40 to 60 kilos of clean fiber per day.

(*c*) One boy or girl who cuts, splits and bundles 10 to 25 bundles of the 15- to 20-centimeter diameter or 30 to 50 bundles of the 8- to 12-centimeter diameter per day; and washes 20 to 40 bundles of the 15- to 20-centimeter diameter or 50 to 75 bundles of the 8- to 12-centimeter diameter or enough bundles to prduce 10 to 25 kilos of clean fiber per day.

A group of 3 to 5 persons is the best to effect the maximum rate of efficiency.

The rate of wages commonly in use in this province is as follows:

1. For cutting, splitting and bundling leaves ready for retting: ₱1.30 to ₱2 for every 100 bundles, 15 to 20 centimeters in diameter; ₱3 to ₱4 for every 100 bundles, 25 to 30 centimeters in diameter; and ₱1 for every 100 bundles, 8 to 12 centimeters in diameter.
2. For hauling bundles of leaves from field to water, 1 to 3 kilometers distance and retting them: ₱1 for every 100 bundles, 15 to 20 centimeters in diameter; and ₱0.50 for every 100 bundles, 8 to 12 centimeters diameter.
3. For washing retted leaves and drying fibers: ₱1 per 100 bundles, 15 to 20 centimeters in diameter; ₱0.50 per 100 bundles, 8 to 12 centimeters in diameter; and ₱1.50 per picul, dry clean fiber.
4. For cleaning fiber well and baling: ₱0.20 to ₱0.30 per picul when fiber has plenty of dirt or unsound portion to be removed; ₱0.10 per picul when fiber is fairly well cleaned; and ₱0.05 per fardo, 32 kilos weight.

The division between workers and owners varies as follows:

1. When the plantation is close to water: (*a*) Workers get $\frac{3}{5}$ of the fiber; owner gets $\frac{2}{5}$ of the fiber. (*b*) Workers get $\frac{1}{2}$ of the fiber; owner get $\frac{1}{2}$ of the fiber. In some cases the owner will have to pay for the cost of hauling the bundled leaves to the water.
2. When water for retting is far from the plantation: (*a*) Workers get $\frac{2}{3}$ of the fiber; owner gets $\frac{1}{3}$ of the fiber. (*b*) Workers get $\frac{3}{4}$ of the fiber; owner gets $\frac{1}{4}$ of the fiber.
3. When the worker and owner divide the crop as bundled leaves ready for retting: (*a*) Workers get $\frac{1}{2}$ of the quantity of bundled leaves; owner gets $\frac{1}{2}$ of the quantity of bundled leaves.

The owner pays the worker cash for hauling and retting his share and for washing and drying as per regular rate according to the size of the bundles.

(*b*) Worker gets $\frac{1}{2}$ of the bundled leaves, for cutting, splitting and bundling the leaves and for washing and drying the retted leaves; owner gets $\frac{1}{4}$ of the bundled leaves; cartman gets $\frac{1}{4}$ of the bundled leaves for hauling and retting.

(*c*) Worker gets $\frac{1}{3}$ of the bundled leaves; owner gets $\frac{2}{3}$ of the bundled leaves.

The most common basis for dividing the crop is $\frac{1}{3}$ or $\frac{1}{2}$ to the owner and $\frac{2}{3}$ or $\frac{1}{2}$ to the worker. In the majority of cases the worker gets the bigger share.

Intelligent and experienced workers contract to work by paying cash or often act as middlemen in harvesting maguey. They go to owners of plantations and contract to harvest the leaves for a certain sum. This practice is always disadvantageous to the owners. The general practice under this system

of harvesting the maguey is to pay for the number of plants in the entire lot in cash as per agreement between owners and contractors. The following are actual illustrations of the system:

1. Some workers at Araniw, Laoag, contracted to pay the owners ₱0.01 for every three plants, that is, the harvestable leaves of three plants. The leaves of three plants are sufficient to produce 1 kilo of clean fiber more or less. At the lowest prevailing price of ₱0.12 per kilo of the fiber, the contractors made a profit of ₱0.03 or ₱0.02 for every ₱0.01 invested after deducting $\frac{2}{3}$ or $\frac{3}{4}$ of the gross income as the share of the workers. The owner in this particular case realized a gross income of only ₱33.33 per hectare on the basis of 10,000 plants to the hectare.

2. A woman contractor at Boraan, Burgos acting as middleman, contracted for the crop of a maguey farm containing 3,500 square meters for ₱40. This particular plantation actually yielded 15 piculs. At the regular price of ₱8 per picul, she made ₱120. Taking from this gross income $\frac{1}{2}$ as the shares of the workers and the ₱40 for the owner of the plantation, she realized a net profit of ₱20.

3. A person in barrio No. 4, Badoc, employing 5 workers—1 man, 1 woman, and 3 young men—contracted for the maguey crop paying ₱500 for all. The workers were employed 60 days. After giving $\frac{1}{2}$ of the gross returns which totaled ₱600, to the workers the contractor still made a net gain of ₱100. The laborers in this particular case were able to earn ₱2 each a day.

The number of days it takes for retting a bundle of leaves varies according to the size of the bundles, the different periods during the year, general local practice—whether pounding on washing or not and the place for retting—whether fresh or salt water. Conditions being the same, the bigger bundles require more days in water than the smaller ones; more stone covering of the pile to prevent the leaves from being carried away by the current especially in the sea require more days than ordinary covers; retting during the cold months from November to February requires more days in water than during the hot weather from March to June; and the leaves retted in fresh water are kept in water less days than in salt water because the workers remove the pulp by pounding while in salt water they remove the pulp by washing.

In general, bundles of 10 to 15 centimeters in diameter retted in salt water require 12 to 15 days in water during the months of November to February and 8 to 10 days from March to June. During this immersion the retted leaves require only a little pounding to clean the fiber and it is estimated that about a tenth of the retted leaves require pounding. Bundles of the same dimension retted in fresh water require 10 to 14 days

during the period from November to February and 8 to 10 days from March to June. The majority of the retted leaves require pounding on washing. This process requires more labor and is slower than that in salt water.

The ease with which retted maguey leaves are cleaned is one of the important factors which governs the rate of efficiency of the workers. It is thus seen that workers will earn less by pounding the retted leaves than by merely keeping them in water longer in order to wash them easier and extract a greater quantity of fiber at a given time.

The cost of harvesting and retting from a given area can be estimated from the following data:

1. Plantation with at least 25,000 plants to the hectare:

One bundle 15 to 20 centimeters in diameter is made up of 65 to 80 leaves or an average of 75 leaves, 0.8 to 1 meter long, 5 to 6 centimeters wide. The leaves cut from 5 plants suffice to make a bundle as above. A picul of fiber is produced from 120 bundles.

2. Plantation with at least 10,000 plants to the hectare:

One bundle 15 to 20 centimeters in diameter is made up of from 40 to 60 leaves or an average of 45 leaves, 1.2 to 1.8 meters long, 8 to 12 centimeters wide. Leaves cut from 2 plants make a bundle of the dimension mentioned above. A picul of fiber is produced from 75 bundles.

3. The scale of daily wages for a ten-hour working day without meals is ₱1 per day for a man, ₱0.60 for a woman, and ₱0.40 for a boy or girl.

In the harvesting and retting of maguey leaves from a hectare plantation, the procedure and expenditure are as follows:

1. By administration, daily wage basis:

(*a*) One hectare plantation with at least 25,000 plants to the hectare:

For cutting, splitting and bundling the leaves from 1 hectare at the rate of 95 bundles a day, 3 regular laborers—one man, one woman, and a boy or girl—working during 52.5 days at ₱2 per day	₱105.00
For hauling and retting 5,000 bundles, one man with cart and carabao working 10 days at ₱1.50 per day	15.00
For washing 5,000 bundles of retted leaves and drying the fiber, 3 laborers as per above working 27.5 days at ₱2 per day	55.00
For cleaning and baling the crop from 1 hectare, 41.66 piculs of clean fiber, one man working 8 days at ₱1 per day	8.00
Total	183.00

(*b*) One hectare plantation with at least 10,000 plants to the hectare:

For cutting, splitting and bundling the leaves from 1 hectare at the rate of 95 bundles a day, 3 regular laborers—one man, one woman, and a boy or girl—working 52.5 days at ₱2 per day	₱105.00
For hauling 5,000 bundles from field to water and retting them, one man with cart and carabao at ₱1.50 per day working 10 days	15.00
For washing 5,000 bundles of retted leaves and drying the fiber, 3 laborers as above working 27.5 days at ₱2 per day	55.00
For cleaning and baling the crop from 1 hectare, 66.66 piculs clean fiber, one man working 13.5 days at ₱1 per day	13.50
Total	188.50

2. By administration, contract basis:

(*a*) One hectare plantation with at least 25,000 plants to the hectare:

For cutting, splitting and bundling 5,000 bundles at ₱2 per 100 bundles	₱100.00
For hauling 5,000 bundles from field to water and retting them at ₱1 per 100 bundles	50.00
For washing 5,000 bundles of retted leaves and drying the fiber at ₱1 per 100 bundles	50.00
For cleaning and baling the crop from 1 hectare, 41.66 piculs at ₱0.20 per picul	8.33
Total	208.33

(*b*) One hectare plantation with at least 10,000 plants to the hectare:

For cutting, splitting and bundling 5,000 bundles at ₱2 per 100 bundles	₱100.00
For hauling from field to water 5,000 bundles and retting them at ₱1 per 100 bundles	50.00
For washing 5,000 bundles and drying the fiber at ₱1 per 100 bundles	50.00
For cleaning and baling the crop from 1 hectare, 66.66 piculs at ₱0.20 per picul	13.33
Total	213.33

3. By contract, share basis:

(*a*) One hectare plantation with at least 25,000 plants to the hectare:

Proportion of shares		Share of owners		Share of workers	
Owner	Worker	Number in piculs of fiber	Total value at ₱8 per picul	Number in piculs of fiber	Total value at ₱8 per picul
One-half....	One-half......	20.830	₱166.64	20.830	₱166.64
Two-fifths..	Three-fifths...	16.664	133.31	24.996	199.97
One-third...	Two-third.....	13.886	111.09	27.772	222.18
One-fourth..	Three-fourths .	10.415	83.32	31.245	249.96

(*b*) One hectare plantation with at least 10,000 plants to the hectare:

Proportion of shares		Share of owners		Share of workers	
Owner	Worker	Number of piculs of clean fiber	Total value at ₱8 per picul	Number of piculs of clean fiber	Total value at ₱8 per picul
One-half....	One-half......	33.330	₱266.64	33.330	₱266.64
Two-fifths..	Three-fifths...	26.664	213.31	39.996	319.97
One-third...	Two-thirds....	22.220	177.76	44.440	355.52
One-fourth..	Three-fourths.	16.665	133.32	49.995	399.96

(*c*) When the owners and workers divide the crop as bundled leaves ready for retting, their corresponding shares per hectare are:

Proportion of shares		Share of owner			Additional expenses of owner in preparing the fiber	Share of worker		
Owner	Worker	Number of bundles	Equivalent number of piculs of fiber	Total value at ₱8 per picul		Number of bundles	Equivalent number of piculs of fiber	Total value at ₱8 per picul
One-half..	One-half...	2,500	[a] 20.83	₱166.64	₱54.17	2,500	[a] 20.83	166.64
			[b] 33.33	266.64	56.50	....	[b] 33.33	266.64
Two-thirds	One-third..	3,333.3	[a] 27.772	222.18	72.55	1,666.7	[a] 13.886	111.09
			[b] 44.440	355.52	75.55	....	[b] 22.220	177.76

[a] From one hectare plantation containing at least 25,000 plants per hectare.
[b] From one hectare plantation containing at least 10,000 plants per hectare.
[c] Cost of hauling, washing, drying and baling which is credited against the share of the owner.

4. Coöperative work or "Ammuyo."

Under this system planters actually spend less than they should as may be noted in the following:

(*a*) One hectare plantation with at least 25,000 plants to the hectare:

For food, 2 meals, daily, drinks, etc. of 15 persons working 10.5 days to cut, split and bundle the leaves from the plantation........	₱47.25
For food, 2 meals daily, drinks, etc. of 2 men with cart hauling bundled leaves and retting them during 5 days........	3.00
For food, 2 meals daily, drinks, etc. of 15 persons working 5.5 days to wash retted leaves and dry the fiber........	24.75
For food, 2 meals daily, drinks, etc. of 1 man working 8 days cleaning and baling 41.66 piculs clean fiber........	2.40
Total	77.40

(*b*) One hectare plantation with at least 10,000 plants to the hectare:

For food, 2 meals, and drinks, etc. of 15 persons working 10.5 days to cut, split, and bundle harvestable leaves from the plantation	₱47.25
For food, 2 meals per day, drinks, etc. of two men with cart working 5 days hauling bundled leaves and retting them	3.00
For food, 2 meals daily, drinks, etc. of 15 persons working 5.5 days washing the retted leaves and drying the fiber	24.75
For food, 2 meals per day, drinks, etc. of 1 man working 13.5 days cleaning and baling 66.66 piculs of fiber	4.05
Total	79.05

ACTUAL YIELDS

From some selected fields which were visited where the owners or the men in charge could give the actual yields, and where the author of this article was able to determine the actual condition of the plants the following data were obtained:

1. Plantations containing at least 25,000 plants to the hectare:

One in Currimao	6.0	hectares yielding	120	piculs each year
One in Bubon, Burgos	1.5	hectares yielding	30	piculs each year
One in Bubon, Burgos	4.0	hectares yielding	60	piculs each year
One in Pasuquin	2.25	hectares yielding	50	piculs each year
One in Davila, Pasuquin	3.0	hectares yielding	50	piculs each year
One in Badoc	1.0	hectare yielding	30	piculs each year
Total	17.75	hectares yielding	340	piculs each year

Average actual yield per hectare—19.155 piculs yearly.

2. Plantations containing at least 10,000 plants to the hectare:

One in Currimao	0.3	hectare yields	13	piculs every year
One in Boraan, Burgos	0.03	hectare yields	3	piculs every year
One in Boraan, Burgos	0.35	hectare yields	15	piculs every year
One in Davila, Pasuquin	0.09	hectare yields	3	piculs every year
One in Davila, Pasuquin	0.06	hectare yields	2	piculs every year
One in Davila, Pasuquin	0.20	hectare yields	8	piculs every year
One in Nagabungan, Pasuquin	0.04	hectare yields	1	picul every year
Total	1.07	hectares yield	43	piculs every year

Average actual yield per hectare—40.187 piculs yearly.

3. Plantations containing at least 10,000 plants to the hectare, harvested once every two or more years:

One in Nagsanga, Pasuquin	0.03	hectare yields	2.77 piculs
One in Natbawan, Pasuquin	1.70	hectares yield	73.00 piculs

One in Pasuquin	2.25 hectares yield 90.00 piculs
One in Pagudpud, Bangui	1.20 hectares yield 120.00 piculs
Total	5.13 hectares yield 285.77 piculs

Average actual yield per hectare—55.706 piculs.

Good plants producing leaves 1.3 to 2 meters long and 8 to 12 centimeters wide and cropped yearly, will yield 50 to 75 piculs from one hectare; ordinary sized plants, 30 to 50 piculs. Plantations that are cropped once every two years generally yield 80 to 100 piculs every harvest.

Actual observation and study makes it safe to assert that the maguey fields in Ilocos Norte give the following yields:

First-class plantation—50 piculs of clean fiber yearly per hectare.
Second-class plantation—40 piculs of clean fiber yearly per hectare.
Third-class plantation—30 piculs of clean fiber yearly per hectare.
Fourth-class plantation—20 piculs of clean fiber yearly per hectare.

CLASSIFICATION

In general the producers, both owners and workers, do not attempt to classify the fiber. They mix long and short, sound and unsound, and white and brownish. Some producers do not clean and dry the fiber very well before placing it on the market, thinking that they get heavier product per unit quantity this way than if it were well cleaned and dried, which accounts for the low prices offered. Generally the greater part of the local maguey is third and fourth-class fiber.

In a few exceptional cases, workers, especially those from the Province of Ilocos Sur, take pains in classifying the cut leaves before splitting and bundling them for retting, that is, they put sound leaves of uniform length together. Leaves of uniform length but having scars and wounds are put in separate bundles.

The following is the general classification of leaves as to length and size and soundness:

First-class leaves—1.5 to 2 meters long, 10 to 12 centimeters wide.
Second-class leaves—1.1 to 1.4 meters long, 8 to 10 centimeters wide.
Third-class leaves—0.8 to 1 meter long, 7 to 8 centimeters wide.
Fourth-class leaves—less than 0.8 to 0.8 meter long and less than 6 to 6 centimeters wide.

For every 100 piculs of fiber, maguey from Ilocos Norte compares with that from Sinait, Ilocos Sur as follows:

Locality	Classification				
	First	Second	Third	Fourth	Total
Ilocos Norte	None	5	40	55	100
Sinait, Ilocos Sur	None	60	35	5	100

MARKETING

The producers, both owners and workers are greatly handicapped in the marketing of their product because of their ignorance of the elementary principles of agricultural economics and the business side of farming. As a result, merchants and middlemen reap the profit that should go to them from the maguey crop raised.

Most of the producers sell their crop right in their respective localities to small local merchants, representatives of Chinese merchants of Laoag and to middlemen for cash or in exchange for other goods, usually rice and canned goods. Few producers sell their crops to merchants in Laoag, especially those from the northern part of the province; those from the southern part, to merchants in Sinait and Vigan, Ilocos Sur. The big merchants sell the fiber to Manila exporters.

The following were the current prices in the different maguey producing localities during the latter part of January 1928, and also the cost of marketing and current prices at central markets of local producers.

Producing localities	Local price of fiber per picul	Central market for product	Current prices at central market per picul	Distance of producing locality to central market	Cheapest transportation expenses per picul			Difference in favor of central market
					Truck	Bull cart	Sail boat	
	Pesos		*Pesos*	*Km.*	*Pesos*	*Pesos*	*Pesos*	*Pesos*
Laoag and San Nicolas	8.50	Laoag	10.00	5	......	0.10	......	1.40
Sarrat, Vintar and Bacarra	8.50	...do	...do	10	......	0.30	......	1.30
Pasuquin	9.50	...do	...do	16	......	0.30	......	0.30
Davila, Pasuquin	9.00	...do	...do	30	0.50	0.50	......	0.50
Bubon	8.50	...do	...do	35	0.55	0.55	......	0.95
Buraan	8.00	...do	...do	40	0.60	0.60	......	1.40
Bangui	8.00	...do	...do	64	1.00	......	......	1.00
Laoag	8.50	Currimao	11.00	30	0.20	......	......	2.30
Paoay	10.00	...do	...do	7	0.10	0.10	......	0.90
Batac	10.00	...do	...do	12	0.10	0.10	......	0.90
Badoc	11.50	Sinait	12.00	8	......	0.20	......	0.30
Currimao	11.00	Vigan, I. Sur.	12.00	55	......	......	0.30	0.70
Laoag	8.50	...do	...do	84	1.00	......	......	2.50
Bangui	8.00	...do	...do	148	2.00	......	......	2.00

From this table, it can be seen that the local producers could get higher prices by doing the marketing themselves especially if coöperatively. The differences as presented in the above table represent a loss to the direct producers and generally a gain to the small merchants, middlemen and others, who buy most of the fiber from the producers right in their respective localities.

The following illustrates the local bartering system:

Merchandise bartered			Maguey fiber exchanged			
Kind of goods	Quantity	Actual value of goods	Number of kilos	Average unit cash value per kilo	Actual cash value of fiber	Net loss of producer in transaction
		Pesos		Pesos	Pesos	Pesos
Rice	1 cavan	9.30	96	[a] 0.145	13.92	4.62
Do	1 ganta	.40	6	...do...	.87	.47
Corned beef	1 can	.45	5	...do...	.72	.27
Sardines	.....do	.22	3	...do...	.43	.21
Salmon	.....do	.28	4	...do...	.58	.30
Wine	1 "frasco"	.80	10	...do...	1.45	.65

[a] Average of the different local prices in places of production in Ilocos Norte as shown in the preceding table.

The big local merchants sell the fiber to exporters in Manila. Some of the Manila buyers prefer and pay more for salt water retted fiber while others prefer fresh water retted fiber. Machine cleaned fiber costs from ₱2 to ₱3 more per picul than retted maguey.

The prices paid to Ilocos Norte maguey fiber by Manila buyers are generally as follows:

	Per picul
Lot price, mixed classes	₱11.00
Second-class fiber	13.75
Third-class fiber	12.50
Fourth-class fiber	10.00

The local merchants incur the following expenses in the marketing of 1 picul of fiber from Laoag to Manila:

Transportation by bull cart or truck, Laoag to Currimao	₱0.20
Storage charges at Currimao	0.05
Wharfage charges at Currimao	0.02
Loading charges at Currimao, bodega to steamer	0.23
Freight on steamer, Currimao	0.65
Unloading, hauling and storage charges in Manila	0.30
Merchants sales tax (1.5 per cent of ₱11, lot price)	0.17
Commission of agent in Manila (3 per cent of ₱11)	0.33
Deductions due to loss in weight or "reseco" (5 per cent of ₱11)	0.55
Total	₱2.50

Generally, Manila buyers charge only 1 per cent for loss in weight; but for Ilocos Norte fiber they charge 5 per cent because it is dirty and wet. Local producers dry the fiber only one day. Others do not clean the fiber well so that it will weigh more.

GENERAL COST OF PRODUCTION

The following table shows the cost of production under different conditions:

Items	Plantation with 25,000 plants per hectare		Plantation with 10,000 plants per hectare	
	Clay or sandy soil	Stony soil with trees	Clay or sandy soil	Stony soil with trees
Preparation of land	₱0.75	₱249.00	₱0.75	₱249.00
Fencing with barbed wire	120.00	120.00	120.00	120.00
Planting by contract, cash basis	200.00	250.00	80.00	100.00
Cultivation once a year or more	6.00	10.00	6.00	10.00
Harvesting, retting, drying and baling by contract, cash basis	220.82	220.82	263.32	263.32
Total cost of production per hectare	547.57	849.82	470.07	742.32

Under existing conditions, these expenses are the highest probable expenditures that will be incurred in a hectare maguey plantation under the best cultural treatment possible in the locality.

Basing the estimate on the highest cost of production and the average local price of ₱9.32 per picul paid to producers in the different places as given elsewhere in this report, the plantation as mentioned in the preceding table must at least give the following yield in order to be able to pay expenses.

One hectare plantation	First harvest		Second and subsequent harvests	
	Sandy or clay soil	Stony soil with trees	Sandy or clay soil	Stony soil with trees
	Piculs	*Piculs*	*Piculs*	*Piculs*
25,000 plants	58.645	91.182	24.337	24.776
10,000 plants	50.436	79.648	28.900	29.326

A plantation with 25,000 plants to the hectare when yielding only 19.185 piculs per hectare every year can not make a profit and will never pay the actual cost of production by the contract system, cash basis. The planters can make a profit only through the contract system, share basis, in which case the plantation can completely cover the expenses after the ninth harvest in sandy or clay soil or fourteenth harvest in stony soil and can make a yearly net profit of ₱59.60 thereafter, when the owner's share would be $\frac{1}{3}$ of the crop or 6.395 piculs every harvest. It must be noted, however, that under different conditions as enumerated elsewhere in this report, the same plantation is capable of producing 25 piculs, 30 piculs and 41.66 piculs per hectare, with a proportionate increase in profit.

On the other hand, a plantation with 10,000 plants per hectare giving 40.187 piculs yearly can pay the whole cost of production and make ₱9.67 net profit after the second harvest and ₱105.19 net profit on subsequent harvests by the contract system, cash basis, in the case of sandy or clay soil; and in the case of stony soil the plantation can completely pay the cost of production from the fifth crop with a net profit of ₱36.94 and in subsequent harvests with a yearly net profit of ₱101.25.

Under present conditions the best system to insure profit to owners of plantations is by the contract system, share basis.

GENERAL REMARKS

The present maguey plantations are in most cases neglected. Producers do not follow the best cultural practices in order to produce the greatest quantity and the best quality of product. Plantations are overcrowded with suckers, unprotected by fences from stray animals and uncultivated. There are, however, a few small new plantations here and there that are fairly good as to general vigor and growth but they are also uncultivated.

Producers in general do not, in the majority of cases, attempt to classify the product. As a result, the local maguey is losing its prestige among discriminating merchants. Some producers too do not attempt to clean their product well and do not dry the fiber thoroughly so it will weigh heavier; on the other hand, there are local merchants too that in their desire to secure greater profit do not pay higher prices for better product commensurate with the extra labor done by the producers in the production of clean, well dried fiber. Both practices are destructive to the industry and should be discouraged.

Because of the present low actual yield of local plantations it is to the mutual interest of both owners and workers to divide the crop produced on a contract, share basis: one-half to owner and one-half to the worker, the owner bearing the expenses of hauling; or, one-third to owner and two-thirds to workers, all expenses to be borne by the worker being the best arrangement. The owners will make a little net profit on their investments after some harvests as may be seen elsewhere in this report and the workers too will realize fairly high wages from the value of their shares. In this case, man-labor receives an equivalent value of his earnings as from ₱0.92 to ₱2 per day or an average of 1.435, woman-labor from ₱0.65 to ₱1.50 per day or an average of ₱1.078, and boy or girl from ₱0.48 to ₱0.90 or ₱0.69.

Under prevailing general local practices, the workers are receiving the greatest benefit from the industry. It is the best means at present from which they can derive a reasonable income. Merchants too make a considerable profit. Owners who do not work the plantation and depend solely on the labor of others do not get much profit on their investment at present. However, if owners can produce a yield of 50 piculs or more per hectare, they can get one of the most comfortable incomes that can be obtained from a farm under local conditions.

There is sufficient local labor supply at present engaged in the industry. There are, though, places where local labor is reluctant to work because it is not used to it. However, labor from Ilocos Sur is available. The local acreage of the plantations is not sufficient to provide enough work for laborers who are actually engaged in the work at present. Most of the planted areas are sufficient to provide work for only two months. There are still extensive areas available for planting maguey in the best maguey districts of this province. If these areas could only be made available to workers so that they could build their homes on them and work them, a family would be able to take care of a plantation 3 to 5 hectares in extension and would be able to make a gross income of not less than ₱1,000 to ₱2,000 a year, under present conditions, devoting their full attention to maguey as their major crop.

The producers are not getting the full money value of their products because they are not able to handle wisely the marketing of their crops. This is due to the lack of sufficient knowledge in the elementary principles of agricultural economics and the business side of farming among the producers. The organization of a producers' coöperative association among the maguey producers in this province would be a great help.

FROM OUR CONTEMPORARIES

POSTAL REVENUE FOR GRASSHOPPER CONTROL

During the past few years Mexico suffered enormous losses from the attacks of grasshoppers. To combat this pest funds were created from the sale of additional one-centavo stamps which were decreed by the President to be carried on all domestic matter in addition to the regular postage.—*Journal of Economic Entomology.*

An improved method of protecting fowls against chicken pox by vaccination has been discovered by Dr. J. R. Beach. The vaccine is made from the entire combs of cockerels killed from nine to twelve days after inoculation with the chicken pox virus. The vaccine "is capable of producing in fowls within twenty-eight days after administration either complete immunity or a high degree of resistance to artificial infection with chicken pox virus."—*The California Countryman.*

RED SQUILL AS A RAT POISON

The poison is extracted from the red squill bulb (*Urginea maritima*) which abounds on the sandy shores of the Mediterranean Sea. It may be applied in the powdered or liquid form, by bread, or mixed with fat or syrup.—*The Agricultural Gazette of New South Wales.*

CLOVER AND MALARIA

"In a letter to *The Times* of August 29, Sir William Willcocks, writing from Cairo, relates cases of where the introduction of the wild clover plant into parts of the Argentine and Holland secured the disappearance of the malaria mosquito in those parts, and how the profusion of clover fields in the Delta of the

Nile, which are allowed to flower profusely, through months of the year, saved Egypt from the malaria mosquito."—*Tropical Life*.

The prevalence of sugar-cane mosaic and root diseases in the state of Louisiana and other parts of the South has led to the organization by the United States Department of Agriculture of an expedition under the leadership of Dr. E. W. Brandes, sugar plant specialist, that will search the wilds of New Guinea for disease-resistant cane varieties. Sugar cane is believed to be indigenous to New Guinea. An airplane will be used by the party, which is composed of prominent sugar-cane specialists.—*The Planter and Sugar Manufacturer*.

Courtesy of Sugar News

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SPECIALIZATION IN AGRICULTURE[1]

By RAFAEL R. ALUNAN

Secretary of Agriculture and Natural Resources

MR. PRESIDENT, GENTLEMEN:

In previous congresses and conventions of tillers of the soil I was one of you and came with you to study the problems of agriculture and help to defend our common interests. Now I come, invited by you, as head of one of the executive departments of the Government, and though I cannot prevent my being looked upon as such on this occasion, I desire to say to you that I still consider and will always consider myself as one of you.

I am first of all an agriculturist like each and every one of you. Agriculture has offered me the most exceptional opportunities of my life. What little I have achieved was done on the farm, and I believe that I chiefly owe my present position to my being an agriculturist. It is therefore perfectly natural that in the Government I should continue to consider myself as one of you, and I believe I shall be better able to perform the duties of my office if I think, feel, and act at all times like an agriculturist.

I desire to state here that one of the greatest ambitions that I cherish in joining the Government is to make the farmers of our country feel that the Government is theirs, just as it belongs to all the other elements and classes of our people. I cannot allow the continuation of that apparent estrangement between the Government and the farmers. We must not tolerate your continuing under the impression that the Government is an institution foreign to agriculture which may or may not assist you, for reasons of which you are not aware. I shall, while I am head of the Department of Agriculture and Natural Resources, endeavor to act in such a manner as to make you feel that this Government is in the long run yours, that this Government actually aids the farmers whenever it can do so with benefit to them and the country in general.

[1] Address delivered before the Eighth Agricultural Congress held in Manila, September 11–14, 1928.

As I said before, I am here as a member of the executive branch of the Government, because it is in that capacity that you have invited me; but I believe I am here also as one of you, and, as I consider my capacity as an agriculturist the higher, I prefer to begin my speech as one of you.

I believe that two things are necessary in order that these Agricultural Congresses may be of practical value to the country in general: First, specialization in their work, and second, elimination of the belief in and the habit of depending for everything upon the Government.

By specialization I mean that the Agricultural Congress must endeavor to serve each class or group of farmers in the best manner possible, giving special attention to the particular problems and needs of each group or class. The era of generalization is past and we are now in the era of specialization. An Agricultural Congress attended by the agriculturists of all classes the sugar planters as well as the rice growers, the cattle raisers as well as the hemp producers, the coconut as well as the tobacco planters must necessarily endeavor to give ear to the different desires of all the different groups, and in the majority of cases the ultimate result is that it does nothing or very little for any one of these classes.

The problems of the different groups of farmers are so many and so diverse that they cannot and must not be considered all at once. The hemp grower is not interested in the problems of the rice grower nor does the coconut planter worry about those of the livestockman; so when matters affecting one determined group are being considered, the others either cannot do anything or if they do participate they do so without the understanding, preparation, or interest with which they would discuss problems of their own.

Moreover, I believe I am not revealing any secret when I say that in some cases the interests of the several groups are openly antagonistic to each other. The questions of the importation of draft cattle from Cambodia, the importation of rice from Saigon, the importation of Chinese laborers, not to mention others, that were submitted to previous Congresses, prove the truth of what I am saying. In those cases the Agricultural Congress offered the sorry spectacle of a house divided against itself.

In recommending specialization according to the several classes of farmers, I am guided by the experience of the Philippine Sugar Association over which I unworthily preside, and the con-

ventions of sugar producers held each year by the members of the Association. The association and the conventions of the sugar growers are kept alive and active because they work for the solution of the peculiar problems, and for the satisfaction of the particular needs, of the sugar growers only, so that their members attend the meetings confident that the experts will suggest things that can aid them to overcome the difficulties which they encounter every day in their work in the field or mill and in the production or the marketing of their produce. The success of our association and our conventions can be judged by the fact that now, a few years after their organization, the associated sugar growers begin to see the necessity of taking into consideration, in order that their work may bring better returns, factors and things of which they were hitherto uninformed or to which they paid no attention and the usefulness of which they see demonstrated immediately by the results obtained.

I would venture to suggest the organization of independent assemblies or meetings for each group or class of farmers which might be held at the same time under the auspices of a central organization, say, the Chamber of Agriculture which, as I am told, already exists, and which can be the link among all agriculturists and their agency for the consideration of their common problems and the defense of their common interests.

The second necessity for these Agricultural Congresses to which I have made reference will be largely satisfied by the solution of the first problem. I have read in the newspapers that many farmers do not feel like coming to the Congress because the resolutions and recommendations of previous Congresses have not been heeded or attended to by the Government. This means that, for many farmers, the utility of these Congresses depends exclusively upon the aid they may receive from the Government in carrying out their recommendations. But I say that when there is specialization of work in the manner suggested; when the farmers study their problems in accordance with the specialty of each of them, they will see that they can not look to the Government for everything and will become convinced that they themselves have to do a great deal.

What is now happening to the farmers in general is what happened to the crew of a certain ship. They ran out of drinking-water and signaled for relief to another vessel that happened to pass by. The reply they received was that all they had to do was to drop their buckets overboard because the water there was fresh and perfectly good to drink. The crew of the first

ship believed they were out in the open sea and that the water was salty, while they were actually in the wide mouth of a river. I can, therefore, tell the farmers to drop their buckets overboard, to study their problems themselves and work out their own salvation.

The Government, on its part, will not spare any effort to give the farmers such assistance as it can. I do not wish to tell you what I intend to do or not to do as Secretary of Agriculture and Natural Resources. But, being one of you, being a man who has been reared as an agriculturist, I think you can believe me when I tell you that I shall always stand by you and that you can count on me to do all I can to make your voice heard in the Government councils.

My ideal would be—and I should consider I had done something worth while if I could carry it out—not to leave the Government until I saw established in various parts of the Islands properly equipped and organized experiment stations directed by real experts and good executives, for each and all of the principal agricultural products of our country. And I should consider myself still more fortunate if I were successful in inducing the farmers to establish, either individually or collectively, or in groups, experiment fields of their own for seed selection, fertilizer tests, and experiments calculated to try out the various methods and systems of culture.

It is high time for everyone to realize that intelligent, not to say scientific, agriculture is the only kind of agriculture that is likely to succeed here or elsewhere. To produce the most possible from a given area is always the most economical and profitable course; but under present circumstances it is imperative that we do this. Though we do not lack land as a nation, the area at the disposal of each of us is generally limited. Moreover, we lack capital, and a dearth of laborers is noticeable in certain sections of the country. In this connection you will be interested to know that, while in the Philippines there is one person engaged in agriculture for every two and one-half acres of land, in the United States one person works approximately thirty acres.

The sugar planters were at first skeptical about the utility of the experiments that were being made with the various kinds of sugar cane points for planting. At this moment there is probably not one of them who is not convinced of the advantage of selecting certain varieties of points for a certain class of soil.

Many sugar planters have their own seeding plot or private experiment field, and much more money is gladly spent by many of them for buying the best and most suitable points than there used to be. The same can be said with regard to fertilizers.

Something similar can, perhaps, be done with great benefit as regards other crops. Take rice, for instance. At present, the only great work which the Government is carrying on in order to make our rice-growing districts more productive is the construction of irrigation systems. I do not wish to enter upon a theoretical discussion as to the utility or uselessness of artificial irrigation in a country where rain is as abundant as it is in ours. But it is evident that not all regions can be irrigated, because some lack sufficient sources of water to supply the irrigation systems,while in others natural difficulties make the cost of construction of irrigation systems prohibitive. The cost of constructing an irrigation system is considered excessive and the Government can not undertake it when it runs as high as ₱200 per hectare. I am quite ready to believe that when an improvement involving the obligation to pay that sum or anything nearly as high is proposed to a landowner, he is quite justified in thinking a long time before he decides to put such a burden on his property. The Government is at present confronted by a rather serious situation because of the delinquency in the payment of the annual installments on land with irrigation systems, the funds for the construction of which we borrowed abroad through the issuance of bonds on which we are paying interest. Another problem is that of certain landowners whose holdings are included in partly constructed irrigation systems of old standing, because these landowners, profiting by the experience of the others who preceded them in enjoying the benefits of irrigation and who now find it difficult to pay the installments, are refusing, or refused at one time, to permit the ditches to be laid across their property. Some of these landowners allege that irrigation is too costly considering the benefits derived from it, and, on the other hand, the difficulties that lack of water may cause in the cultivation of rice can be removed or minimized by the use of a suitable kind of seed. What I wish to say is that, with irrigation or without it, seed selection is productive of great benefits which a farmer anxious to secure the largest returns from his work and to establish his business on a solid basis must not ignore. In regions where irrigation is impossible, seed selection becomes a necessity.

But the fundamental problem which now confronts the Filipino farmer, the sugar grower as well as the rice planter, the copra producer and the tobacco planter, is the lack of capital. We must realize that in the Philippine Islands there is not enough capital for agricultural development, and what little there is, is so dear that borrowing it eats up all the profits of the agriculturist. I consider it wasted time to organize agricultural banks and credit associations with local capital. To endeavor to do that is like trying to cover a three-meter table with a one-meter table-cloth.

The only solution of this problem is to seek the assistance of outside capital for the development of our agriculture, giving both the capitalist and the farmer a chance to make money. The Province of Occidental Negros, as I have reason to know, has developed, thanks to capital furnished by British, Spanish, American, Chinese, and German companies who aided in financing agriculture and made large profits. In Iloilo, the wharf over which the bulk of the sugar produced in the Philippines is loaded and unloaded is called after the Englishman Loney, to honor the memory of that foreign capitalist who was the first to aid the Filipino planters of Negros and Iloilo, lending them the money they needed.

Notwithstanding the aid of foreign capital for nearly a century, the lands in Negros are still in the hands of Filipinos. We must not fear foreign capital because it is foreign; but because of the manner in which it comes and is invested in our country. I do not believe there is a country in the world that has been able to develop properly on its own resources exclusively. Even the United States owes its wonderful development to the aid of foreign capital. We must attract foreign capital, giving it the necessary facilities and offering it reasonable advantages, because we need it. But I believe that the best way of attracting foreign capital is to offer it an adequate organization of our agriculture which will furnish it with an easy, clear, and safe method of investment. Thus, we shall, on the other hand, secure to ourselves the advantage of obtaining relatively cheap money, and I believe we can do this without materially changing the present structure of our agriculture.

For the purposes of that organization, all lands must have good titles. I shall make all possible efforts in order that the titles to rural lands, especially in sections where agriculture is sufficiently developed, shall be cleared as rapidly as possible.

A matter that apparently affects only one group of farmers, but which may have consequences that will affect all and that involves a fundamental question of justice, is the proposed limitation of the free admission of Philippine sugar into the United States. If we admit that under the present circumstances the United States is entitled to limit the free entry of Philippine sugar to 500,000 tons, nothing prevents the subsequent limitation of other products, while the United States sends us its products without any limitation.

We must not forget, however, that the American Government has always been guided by justice and that in deciding this question it will endeavor to be just to us. But the farmers must not stand idle and trust to Providence or the Government to do it all. They must defend their own interests seriously and show the justice of their cause in the proper manner.

I shall conclude by congratulating you sincerely upon your determination to hold this Congress. The coöperation of all farmers has at no time been so necessary as at present. Never have the farmers been confronted by such serious problems as those they are facing now. In some respects we are now, so to speak, at the parting of the ways and have to think carefully which path we shall choose. Conditions in our country and abroad have come to such a point that all business men, among whom the farmers must include themselves, must hereafter think in world terms, considering the factors of competition in labor, capital, and market conditions that militate in various countries against our products.

HOW TO BUILD UP AND IMPROVE A HERD OR FLOCK (WITH DESCRIPTION OF THEIR MOST COMMON DISEASES IN THE PHILIPPINES)

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The object of this article is to try to assist the average livestockman in the Islands to grow two kilos of animal products where but one is growing at the present time.

During the writer's travels in the Philippines, which have covered many provinces and extended over a number of years, he has, because of the nature of his work, come in contact with a large number of people who were actually engaged in raising livestock of various kinds, or who contemplated doing so sooner or later. Not many of these people have any definite plans of procedure, or practical ideas for building up and improving their herds or flocks from year to year. Many people who are just starting in the business make an irreparable mistake in the very beginning by buying, for instance, a hopelessly degenerated herd of cattle with just about as many bulls in it as there are cows. They will then put their animals out to pasture in charge of a "caretaker" who knows nothing whatever about the care of animals, how to improve them by breeding, and how to recognize their diseases. These people are beaten from the very start and the fate of their enterprise can be written beforehand in large capitals, and with red ink, in the one word FAILURE. A few people have imported expensive bulls for the purpose of improving the quality of their cattle and have been bitterly disappointed with the results, for reasons that will be referred to presently.

A successful Filipino cattleman quite accurately summed up the situation when he said, quoting a local daily paper, that there are a surprisingly large number of people who seem to think that the only requisite necessary for a beef animal is a tail, two horns, and four legs with four feet.

So many people when speaking of their animals, including all kinds, emphasize the number and make no reference to their quality when, in fact, a large number may not be worth as

much as a very few. A scrub "vaca" when mature may not dress as much, when slaughtered, as a well developed one-year-old calf. Again, the quality of the meat corresponds very closely to that of the animal from which it is derived.

The general custom in the Islands of permitting all classes of animals to run at large with the scrub males of their kind and mate indiscriminately, is so fixed that many people take it for granted that it is the ideal and the only proper or practicable way to raise livestock.

The old Greek philosopher who said that "like begets like" was, in a measure, correct. However, for the sake of accuracy the statement should be modified in effect to "like *tends* to beget like." It does not always do it, but there is a tendency to do so; therefore, the odds are in our favor if we would but take advantage of them.

For instance, if a bull, good or bad, is mated with 40 cows in one year, all that calf crop would contain 50 per cent of the blood of their sire. If the sire is a high type animal of his kind his progeny will inherit, more or less, many of his good qualities. On the other hand, if the sire happens to be a scrub bull, which is altogether too frequently the case, the results are disastrous, for the offspring will inherit the undesirable qualities of their scrub sire and quite possibly to an exaggerated degree. The same general principle will hold more or less true for all animals, "like sire, like son." The safest policy to practise would be to castrate all scrub, as well as surplus, bulls before they reach the age of puberty. Such measures may seem radical but they are justified by the results.

THE NATIVE CATTLE

The full-blood native cattle in the Philippines are probably direct descendants of the Banteng (*Bos sondaicus*), indigenous in their wild state to the Malay Peninsula. As they have no foreign blood in their veins they are very prepotent—meaning that they will transmit their physical characteristics to their progeny regardless of the type of bovine animals with which they are mated.

There are several very distinct types of so-called native cattle in the Islands. One of them is known locally as Batangas, being named after the province in which many of them are raised. They resemble Chinese cattle in physical conformation and probably came from China. They are blocky like beef cattle, very docile, and make splendid draft animals.

There is another type known as Ilocanos that are raised very largely in the Ilocos and Mountain provinces. They resemble very much Cambodian cattle, and are more rangy in conformation than the Batangas type. They are used very extensively for road work as well as for draft purposes.

Another very distinct type of cattle are mottled black and white and are raised on one of the very small islands in the extreme northern part of the Archipelago. They are blocky in conformation and are believed to be of Spanish origin.

All other native cattle in the Islands may be grouped as more or less nondescript types, in view of the fact that they vary greatly in size, color, and conformation. There are many good individuals among them but they do not, as a rule, breed true to any distinct breed or specific type.

The difference in the physical appearance of all so-called native cattle of Oriental origin may be attributed to the difference in the feed and environments of the countries, or localities, in which they were raised after having been domesticated. They have their good qualities and represent the survival of the fittest. If they could have but half a chance in being mated by intelligent selection, generation after generation, and given plenty of good feed first, last, and all the time, they would amply reward their owners in the way of generous profits. Generally speaking the native cattle, as well as all other classes of domestic animals, have been permitted to degenerate until they are pitiful specimens of their kind.

BUILDING UP A HERD OF NATIVE CATTLE

Starting in the cattle business is, in a way, like starting in any other kind of business. It is essential that one have some inclination for, and knowledge of, the business and a readiness to acquire more; close attention to details, and a determination to succeed. In starting it is imperative that one be very exacting in acquiring his foundation stock, taking care that they measure up to a very high standard and begin by selecting large, well-formed, vigorous cows ranging in age, preferably, from two to four years.

One bull is quite sufficient for 20 to 40 cows, and he should be an exceptionally large and vigorous high-caste animal, with a heavy bone, well-developed quarters, from four to six years old, and possessing all the good qualities possible. It would be advisable to see some of his calves, before purchasing, in order to better judge the quality of his offspring. If they

are good and resemble him in physical conformation that would be a good argument in favor of purchasing him for he will influence the quality of the increase in the herd about 50 per cent. In other words, the bull is one-half of the herd. A very choice bull—and that is the only kind worth considering—costs considerably more than an ordinary bull but is well worth it, as he will, conditions being equal, repay the difference in price with compound interest.

ESSENTIALS

A range, or farm, is necessary which should by all means have a sufficient number of strong corrals with a shed built inside for the purpose of protecting the animals during stormy weather. In many places the posts and poles necessary for the construction of the corrals and sheds can be obtained from the nearby timber; and cogon, *talahib,* or *runo* grass will make a very satisfactory covering for the shelter. Inside the corral, and under the shed, there should be a trough which may be hollowed out of a log and securely set up at the right height on poles, for the purpose of salting the animals at least once a week. Cattle are very fond of salt and will soon acquire the habit of voluntarily coming into the corral at night for it. In the evening during the fly and mosquito season the cattle will collect around a smoke if one is provided for them in the corral, in order to keep the biting pests off, and if they are not disturbed they will soon bed down for the night in perfect contentment. During the dry season the droppings, which soon dry sufficiently to burn, make a very satisfactory smudge. In the rainy season they should be hauled out a considerable distance from the corral, or buried deeply, thereby keeping the corral clean at all times of the year.

These simple and inexpensive measures are indispensable in facilitating the work of catching the animals for the purpose of castrating the scrub and surplus bulls, which should be done by the time they are three months of age, and for branding, treating wounds, vaccination, etc.

Again, if the animals are not accustomed to coming into the corral, they soon become so wild that they can no more be controlled than can so many wild deer. All Oriental cattle behave very differently from the way temperate zone cattle do, as they will not herd together when they become excited, but will scatter in all directions and take to cover in the jungle and, for this reason, it is almost an impossibility to round them up or control them after they have become semi-wild.

If there are no boundary fences to the grazing area and it is necessary to herd the animals to keep them under control, and from mingling with other cattle, the caretaker should break some of them to ride and thereby save himself from doing so much walking. Native cattle are readily broken to ride and many of them will soon acquire a very easy riding gait.

In a few years after the herd has increased in numbers, and incidentally quality, as a result of carefully selecting a better and better bull for each succeeding generation, it is time to begin culling out the inferior cows and disposing of them. Both in size and quality the herd should now begin to improve rapidly and eventually reach a high degree of excellence. If this policy is kept up year after year, and generation after generation, the results will be very gratifying in terms of accomplishments and pecuniary rewards.

These suggestions are made for those who contemplate going into the cattle-raising industry with very limited capital and must, of necessity, make every peso count from the very beginning. There is a big advantage, in a race, in getting off to a good start, which holds just as true in the livestock business. For future reference this plan will be referred to as Ranch Plan No. 1.

It could be greatly improved upon if the ranch or farm was fenced with a taut four- or five-strand barbed wire fence with the posts not exceeding three meters apart for the boundary, and cross fences to divide the ranch, or farm, into separate pastures in order that the cattle may be kept separated one lot from another. This procedure would also serve to keep out intruding cattle, lessen the danger of disease, and provide the necessary facilities for weaning and mating at the proper season of the year, etc. Three months in the year is a sufficient time for the bull to run with the cows and the time of the year would vary, in different parts of the Islands, depending upon the rainy season for the particular locality. This would assure a calf crop of about the same size each year. The end of the rainy season would be the best time for the calves to be born, as at that season of the year the grass is at its nutritional best and, consequently, the cows are in the best physical condition for calving and raising their calves. When the calves are from six to eight months old they should be taken away from their mothers and placed in another pasture. This would give the cows a chance to recuperate in physical condition each year before calving again. Many native cows will not wean their

last year's calf, and when the next one is born it does not get sufficient milk. Instances have been known where a cow would be nursing *three generations* of her offspring at the same time, which means that the youngest one must starve to death or become hopelessly stunted in growth and, therefore, worthless.

There should also be a caretaker's house, with such additional buildings as necessary, which could be built out of either cheap or expensive material, depending altogether upon circumstances. If it is the intention to improve the ranch and make a real home out of it worthy of the name then naturally the improvement should be made on a permanent basis. Fruit trees should be planted and certain fertile areas fenced off for the raising of such food crops as desired. It would also be advisable to plant some forage crops for work animals.

No detailed plan can be offered in plotting or laying out a livestock ranch, or farm, for the reason that what would be applicable in one case would not apply to another, as so much depends upon accessibility, extent of grass covered area, and the approximate number and kind of animals that the range will carry, etc. For future reference this plan will be referred to as Ranch Plan No. 2.

The average material for making fence posts is decidedly short-lived and unsatisfactory. Live post materials, like kapok, madre-cacao, and others, are not always available nor very satisfactory. Posts made from certain first-group woods and set in a concrete base will last a number of years. Concrete posts while costing a little more primarily would probably be cheaper in the end on account of their durability. In some places natural boundaries, like deep canyons, rivers with high banks, etc., could be utilized to some advantage.

CARABAOS

It is frequently remarked by observing people that the quality of the carabaos in the Islands is degenerating from year to year, which may be attributed to a combination of conditions. The largest number of carabaos are raised in the rice-producing sections in the Islands, and in this respect differ from the cattle, which are generally raised on the uncultivated lands.

There is an old law still in effect that forbids the slaughter of carabaos for meat unless such animals are unfit for agricultural work or draft purposes. The law in question was enacted at a time when rinderpest was rampant and threatened to destroy the entire cattle industry in the Islands. Many people who owned carabaos at that time were slaughtering them and

selling them for meat believing that sooner or later their animals would become infected with the disease and die, and that it was better to market them for what they could get rather than take the chance of a total loss.

The law has served the purpose for which it was intended and is now acting adversely to the carabao industry in this way: The cattle buyers go into the districts where the carabaos are raised and purchase the very best animals, year after year, and ship them out, leaving nothing to breed from except the very inferior ones having no market value. This process has been going on for a number of years and as a result the quality of the animals has been deteriorating generation after generation.

The sugar planters, who have been buying most of the carabaos coming from the breeding districts, are insisting on better animals, preferably Cambodian carabaos, for their purpose and consequently there is but little demand or opportunity to sell the inferior animals that are left on hand. They have been increasing in number year after year until the country is overstocked with such animals to beget their kind, and their greatest value is what can be obtained for them when slaughtered for meat.

With the great progress that has been made in the Philippines during recent years in combating rinderpest it is not such a dreadful disease to deal with now as when the law was passed, and it is very improbable that any very great losses will ever again occur from it in the Islands.

INDIAN CATTLE (*Bos indicus*)

A number of Indian cattle, of which there are several very distinct types, have been imported from time to time to cross with native cattle. The Indian cattle that have been kept clean of foreign blood for many generations are also very prepotent animals.

The first cross between the Indian and native cattle looks promising, for the time being, as it is frequently a better animal than either one of its parents. If we were to stop here and market these animals for beef or work purposes and not try to raise other animals from these cross-breds, the cross could be considered as a great success. However, if we continue to raise cattle of this kind the parent stock would have to be renewed from time to time in order to get the maximum of perfection in such a cross, which is the first one. The second one is not to be considered for reasons that are forthcoming.

Having arrived at the cross-roads, figuratively speaking, with the first crop of cross-breds, we should take one road or the other, and the one we take we must stay on in order to arrive anywhere. If we take the "Indian road" and mate the full-blood Indian with the cross-breds for several generations, not less than four, the full-blood Indian type and characteristics will again become dominant; or vice versa, if we take the "native road" under similar conditions. These general principles hold true in the breeding of any kind of animals.

But if we take neither road and permit the indiscriminate mating of first one type of animal and then another we shall arrive no place, for we are violating the most elementary law of livestock breeding.

Much of the prejudice against the Indian cattle is due, very largely, to the results of crossing grade Indian bulls with either grade Indian, or native, cows. The fault is not altogether with the Indian breed of cattle, as the same results or possibly worse might ensue with any other breed of cattle under similar circumstances. The error lies in the injudicious mating with grade bulls, for they are not sufficiently prepotent to transmit their likeness to their progeny.

All herbivorous cross-bred males, such as horses, cattle, sheep and goats, should be castrated, or slaughtered, before they reach the age of puberty, or otherwise prevented from reproducing their kind.

The keeping of cross-bred males for breeding purposes is the most *common pitfall,* and *downfall,* of *livestock breeders.* Such animals *should not be mated,* no matter how promising they may look, for the reason that they are not sufficiently full-blooded to transmit their similarity to their offspring. After the fourth cross, preferably more, from a full-blood sire with dams equaling them in pure-blood, they may, if sufficiently good in physical conformation and otherwise, be used for breeding purposes. But even then with this amount of pure-blood there is occasionally a reversion to some ancestral type.

There is a wide-spread belief in the Islands, overcapitalized by some people, that Indian cattle are immune to rinderpest. This is not exactly true. The fact is that a few have acquired more or less immunity to the disease, as have many native cattle and carabaos. The enormous loss of Indian cattle in India during the year 1927 as officially reported would indicate that not all Indian cattle are immune to rinderpest. This is no reflection, however, on the relative merits of Indian cattle, as

no breed of cattle is known that has a natural immunity to the disease.

Indian cattle, like all other Oriental cattle, have the advantage over temperate zone cattle of being able to live on the country.

SHEEP AND GOATS

It has been said that sheep and goats are distant cousins under the skin but it is very doubtful, since they will seldom, if ever, reproduce for the reason that they have odd chromosomes. The animals that are mistaken by some people to be a cross between a sheep and goat are sometimes difficult to differentiate without examining the upper lip, which is cleft in the sheep but not in the goat. This arrangement permits the sheep to do close grazing, which the cattlemen object to for the reason that their cattle have no chance on the same pastures with sheep. The sheep feeds with its head on the ground and is known as a grazer, while the goat, all breeds, feeds by preference with head up and is known as a browser. This peculiarity of the goat's is taken advantage of by settlers in bush country to clear their lands of scrub growth. In Texas enormous numbers of Angora goats are raised on bushy land to clear it for cultivation, and in the meantime the settlers profit by the annual clip of hair, known as mohair, which finds a ready market for the manufacture of cloth, while the flesh of the animal when slaughtered is used extensively as a substitute for mutton. In the Prairie Downs section of Queensland large numbers of goats are raised for slaughter and shipped to Europe in cold storage for sale.

Goats are raised quite extensively in the Islands. No one raises many of them but many people raise a few of them. There are some very good milk as well as meat types among them. With proper selection in breeding two very distinct and useful types could be built up.

There have been several different breeds of milch goats imported into the Islands, viz., the Maltese, Spanish, Indian, and Anglo-Nubian. The two former, both of them having long hair, did not thrive. The Indian goats are long-legged, short-haired animals and apparently will thrive about as well in the Islands as the native goats. Many of them have large udders and will give a liberal amount of milk and would, no doubt, do much better if they were bred up by careful selection. Wherever East Indian soldiers are stationed, if in the Far East, there are generally a large number of these goats that are kept

for dairy purposes, and their flesh finds a ready sale to the soldiers. There may be something more than a mere coincidence between the physical development of the East Indian and the large amount of goat's milk that he consumes, which will be subsequently referred to under the heading of "Dairying."

The few Anglo-Nubian goats in the Islands are of very recent importation and nothing definite is known as to whether or not they will thrive in the Islands.

In the States there are a number of goat dairies and the milk finds ready sale to certain hospitals, particularly those for children. Goats are very rarely affected with tuberculosis, their milk having an advantage, in this respect, over cow's milk.

If cleanly methods are used in milking goats and the utensils are kept strictly clean the milk is very palatable and is difficult to differentiate from cow's milk.

Goats multiply rapidly, mature early, and can be raised on land that will not subsist any other kind of domestic animal, and many more of them should be raised. A very necessary precaution, however, in raising goats is to provide them with perfectly dry quarters to protect them from rains and storms. Their most common diseases will be discussed under "Communicable Diseases of Sheep and Goats."

The largest number of so-called native sheep found in the Islands are raised along the Ilocos coast lines north of Manila. They are composed of small flocks varying in color from black to white, or are both black and white. They have a coarse and thin wool which is seldom or never clipped. The flesh apparently is not in very high favor with the people, and the wool has little, if any, commercial value.

A few young, well-selected ewes are being used as foundation stock for crossing with imported Shropshire rams. So far three generations have been produced at the Alabang Stock Farm of the Bureau of Agriculture, and two crosses have been obtained at the Trinidad Agricultural School, subprovince of Benguet, by the Bureau of Education. The grades in both instances look promising and it is believed that if the follow-up system is strictly adhered to for several more generations a very good combination wool and mutton sheep can be produced.

Sheep were the very first animals to be improved upon by selection in breeding, and this was done by Bakewell, who developed the Merino sheep, which is considered to be one of the best long-wool breeds of today.

A number of years ago there were a few Shropshire sheep of both sexes imported from Australia. Mr. Haight, the proprietor of Haight's Place, some 50 to 60 kilometers from Baguio, obtained a start from the original importation and has been very successful in raising full-blood Shropshire sheep at an altitude of about 6,000 feet. The animals have prospered beyond all expectations, and successfully weathered the storms in that locality that kill native ponies and carabaos. The sheep frequently lamb out in the open during severe storms, with no bad effects on either the mother or her offspring.

The sheep are clipped at the end of the rainy season and the wool used for filling bed-comforters and for other useful household purposes.

The flesh is most palatable and is considered by connoisseurs to be of very good quality. However, few people at first like mutton and, as with olives, must acquire a taste for it; but that once acquired it is always desired. The palatability of the meat depends much upon the quality of the feed the animal eats, the method of slaughter, and the manner of cooking.

There is an enormous area of treeless but grass-covered land, particularly in northern Luzon, that varies from hilly to mountainous in character that would carry cattle and, in the higher altitudes, it is believed that a very good combination mutton and wool-producing sheep could be raised successfully. If so it would open up an unexploited livestock industry in the Islands having enormous possibilities on otherwise more or less valueless land.

Governor Early of the Mountain Province, and Mr. James A. Wright, principal of the Trinidad Agricultural School, subprovince of Benguet, are very enthusiastic over the possibilities of sheep raising in the highlands of northern Luzon.

PHILIPPINE PONIES

Nothing definite is known as to the origin of Philippine ponies, but it is generally believed that they are descendants of Arabian horses brought to the island of Jolo long before the advent of the Spaniards in the Philippines. Their prototype may be found in a number of neighboring countries in the Far East, particularly in Sumatra, Java, Siam, India, and Indo-China. The slight difference in type may be attributed to the feed and environments of the localities in which they are raised.

The smallest ponies known have been produced in Korea, some of them not exceeding nine hands (36 inches) in height,

while the largest horse ever known was foaled, raised, and recently died in Iowa.

Probably the best type of Philippine ponies are raised in Batangas Province, south of Manila. This may be attributed to the better breeding methods practised by the people there and to the quality of the soil that produces feed that has more nutritional value than in some other localities in the Islands.

The general custom of the people who raise ponies is to sell their very best stallions from year to year and they are generally taken to the large centers of population for driving purposes. The stallions that are left in the provinces to breed from are the ill-formed and generally worthless ones for which there is no sale. These worthless stallions are turned loose, in an unfenced country, and permitted to mingle with the brood mares of the locality to find their living, beget their own kind, and eventually die. It is unfortunate for every one concerned that they do not die the very day they are turned loose.

That such animals run loose in a community should be a matter of public concern, as they are not only a menace to the future quality of the ponies raised in the Islands, but they are no insignificant factor in the distribution of such dangerous communicable diseases as surra and glanders. They also eat the feed that is needed, particularly in the dry season, by the brood mares.

Such animals should be castrated; or tied up or confined to fenced pastures; or otherwise prevented from reproducing their kind.

Municipal governments could do much in improving the general qualities of the ponies in the Islands and lessen the spread of dangerous communicable diseases among them by passing appropriate ordinances, and enforcing them, prohibiting any one from turning stallions loose after they have arrived at the age of puberty. The old theory of some people that horses lose their "ambition" after being castrated is untenable in this enlightened age. It is true that they frequently lose the squeal and viciousness but neither one of these may be considered as ambition. If any proofs to the contrary are desired note the horses in the U. S. Cavalry and the general practice in all the foremost livestock-producing countries of the world.

It is believed that municipal governments will sooner or later see the wisdom of taking more interest in the quality of livestock that is produced in their municipal districts, which would

be to their best interest as well as to every one who lives in their jurisdictions.

It has often been said, and by people who know, that the Philippine horse or pony is the best piece of horse-flesh in the world for his inches. Notwithstanding the very high compliment there are altogether too many of them that are undersized and faulty in conformation.

It may be wondered why the Philippine ponies maintain the high standard that they do, under such adverse circumstances, which may be explained by the fact that they are pure-breds; that is they have had no admixture of alien blood in their veins for many generations—and blood will tell every time.

If the Philippine pony had a fighting chance by being bred by reasonably intelligent selection and given plenty of good feed first, last, and all the time, and not worked until at least *four,* and preferably *five,* years of age, it would increase in height fully two inches within the first few generations.

THE MULE

There appears to be much confusion, among all nationalities, as to the temperament and origin of the mule. It is probably the most maligned animal in the world, notwithstanding the fact that its progenitor is conspicuously connected with Biblical times. There is an old saying that it has neither pride of ancestry nor hope of posterity, as it is a hybrid, and usually sterile. People who have had the most to do with mules are their best friends, and quickly resent the libel that a mule is a habitual kicker. The fact is that there is no equine animal that is so responsive to proper treatment as is the mule, which is the offspring of a jackass, also known as a jack, and a mare. The female of the species, sister of the jackass, is known as a jennet, and the offspring between a jennet and a stallion is known as a hinny. As a rule the hinny is more feminine in general appearance than the mule.

The ancestor of the jackass is the wild ass of Africa and Asia. The jack and his sister the jennet may vary in size from a large dog to that of a draft horse. The small ones in some countries are frequently called donkeys, while in the States they are generally called burros. Jacks are bred up to a very high degree of perfection, of various types, in Spain, France, Italy, Portugal, and in the United States, and good ones command very high prices.

The first jack to be imported into the United States was presented by the King of Spain to George Washington, and was named Royal Gift. The jack was kept on Washington's livestock farm at Mt. Vernon and sired a number of mules which found ready sale at good prices. Later, Henry Clay, the statesman, orator, and livestockman, imported a jack which was kept on his famous livestock farm in Kentucky. Mules became very popular draft animals in the States and many more jacks were imported, and now many mules are raised in nearly every state in the Union, with Missouri leading all others in production, as well as having the largest mule market in the world, at St. Louis.

A number of years ago the Government imported a few burros, of both sexes, from the States with the object in view of using them in the hill country for pack animals. There are four burro-mules (burrojack crossed with native mares) known to exist at the present time in the Province of Ilocos Sur. These animals are, no doubt, the result of that importation and are larger than the native pony, and apparently thrive better than the native pony on local feeds. They are well formed and active and would make splendid riding animals for mountainous regions.

Generally speaking, mules in the Philippines, if properly fed, do as well if not better than they do in the land of their nativity.

SWINE

So far as known no one has ever made much of a success in raising hogs in the Islands on a very large scale, though a few people who have plots of land convenient to military barracks, large hotels, dormitories, convents, etc., where they may obtain more or less cheap feed for the pigs in the form of table refuse have done fairly well. Notwithstanding this fact, in the aggregate there are many hogs raised in the Islands. Many people will purchase a pig or two at weaning time, put them into a small pen raised a few feet above the ground, and raise them very largely on the refuse from their tables and kitchens that would otherwise go to waste. Contrary to popular belief hogs are not slaughtered for market or consumption that have not been kept up and fed. The hogs that may be seen running loose in nearly every municipality in the Islands are for the most part the brood sows and they are not slaughtered and put on the market in the physical condition in which people notice them and thereby arrive at erroneous conclusions. People in the Islands who raise hogs are of the opinion that when the brood sows

are permitted to run loose they are more prolific than when they are confined in close quarters, an opinion that would seem to be well founded, for the average native brood sow produces large litters of pigs. After the pigs have arrived at the weaning stage they are sold to people who raise them in the way above stated. The native hog arrives at maturity very slowly and is frequently 18 months to two years of age before it is finished for the market. This feature could be greatly improved upon by crossing the native sows with imported boars, of any type, provided they are of the improved breeds. The resulting cross-breds can be fattened for the market much quicker than the full-blood native hogs and will weigh anywhere from one-third to 50 per cent more when fully matured.

The secret of success in raising any kind of beef cattle or hogs for the market lies very largely in quick production and marketing and thereby conversion into cash in the very shortest time possible. The practice not only economizes on feed but lessens the risk of total loss through diseases or otherwise.

There would appear to be an opportunity in every municipality in the Islands as well as in a number of the larger barrios for a person, or several of them, to keep a good boar, or two, of any of the well-known breeds, for public service. He would be perfectly justified in charging a reasonable fee for the service of the animal or, in lieu of cash, make an agreement with the owner of the brood sow that he is to receive one of the pigs at weaning time, in return for the service of the boar. It is believed when people saw the advantage derived from such a cross that there would be no hesitancy in taking advantage of such an opportunity.

A party living in the provinces not far from Manila kept a pure-bred Berkshire boar for his own use and for public service, as above described, and profited thereby from the fees and income from the public service about ₱125 in two years, in addition to the benefits derived from the cross-breeding with his own brood sows. He then traded the boar for a consideration which he valued to be worth about ₱100, which would make a clear profit of ₱225 in two years on one boar, in addition to the pigs that he raised for himself that were sired by the boar.

Fresh pork is always in demand in the Islands and commands a very good price, and more people might profit by keeping a pig or two to fatten on the table and kitchen refuse that would otherwise go to waste.

CHICKENS

It would be quite an exception to meet any one who is not interested in poultry, either directly or indirectly—if not in its production then in its consumption, as it is something that all of us have to do with, more or less, every day.

In the States the poultry industry ranks about third in value of all farm products, and in the Philippines the aggregate value of poultry is believed to exceed that of cattle. No one in the Islands raises a large number of any kind of poultry but many people raise some of various kinds to supply their own needs and market the surplus. It is stated that more than a million pesos go out of the Islands annually, principally to China, for poultry and eggs, which makes it evident that the demand is greater than the local supply. There is no logical reason why all this money should go out of the country every year for something that should be and could be produced here. The problem could, no doubt, be very largely solved if the manner of production were improved upon; which, it is believed, could be done and that by very simple methods.

No matter where one goes in the Islands the custom of keeping as many, if not more, roosters than hens is the general rule. The hens in the Islands are not necessarily polyandrous any more than the hens are in countries where people make a success of the poultry industry. The roosters are non-producers of eggs and are trouble makers in more ways than one, and consume as much feed as the hens, which are the actual income producers. The remedy would seem to be in eliminating so many roosters and keeping more hens, particularly of the egg-producing kind or of the good quality type for broilers, or of both (dual-purpose) types. One rooster to eight or ten hens is quite sufficient for all practical purposes, and any more are a detriment, as they not only annoy the hens with young chicks very much, but frequently trample and maim or actually kill the little ones.

People who make the greatest success of raising poultry on a large scale, for egg-production, as on the Pacific coast, *keep no roosters* at all with the hens that are laying eggs for the market. The eggs keep much better without having been fertilized, and the hens will lay just as many eggs without the roosters. The rooster is kept only in the pen with the specially selected hens with the object in view of using these particular eggs for hatching purposes, and then not to exceed one rooster to eight or ten hens—and they in a pen to themselves. The reason for this

would seem to be too obvious to require an explanation. They even go further than this by checking up on the slackers. If a hen is not laying a sufficient number of eggs to pay for her keep she is promptly culled out of the flock and sent to market. As a purely business proposition successful poultrymen do not find it profitable nor will they keep hens that do not pay their way, and much less will they harbor a number of nondescript roosters.

If a person is not raising chickens on a large scale, an incubator is not a necessity. In substituting hens for an incubator it is much better to set two hens at the same time and when the eggs hatch, and before the hens are taken off the nest with the little chickens, to put all the little chicks under one hen, preferably at night. Under these conditions the foster mother will accept the other hen's little chickens as her own and can be taken off the nest the following morning with all the little chickens. Then pen the other hen up out of sight and out of hearing of the young chickens for five or six days, when she will, in all probability, have fogotten her little chickens and will soon go to laying eggs again and thereby pay her way in egg-production.

It is a loss of time, and consequently money, to permit a hen to run with but two or three little chickens, unless they are of the highly improved breeds. It would be much better to humanely kill the two or three little chickens, if they are of the ordinary kind, and thereby permit the mother to go back to laying eggs. It is not an unusual thing to see two hens mothering but two or three chickens and sometimes but one only. This is lost motion, equivalent to lost money, which does not pay in any kind of business.

There are say two different types of native chickens that could be built up and improved upon by careful selection, generation after generation, that would be worth considering. One of them is a plump, speckled bird, of medium weight, with well-developed comb and wattles; small and medium tail feathers, and preferably yellow colored legs. It is believed that this type could be developed into a very good dual-purpose chicken—for both eggs and broilers. The other type is the Malay game chicken, of which there are two very distinct types and they too could be built up, and improved upon very materially, for the purposes their name indicates. One of this particular type is raised in Jolo and resembles very much in conformation the red-breasted Cornish game chickens with the exception that they are not so large and are black, or nearly so, in color.

Nearly all the other kinds of native chickens found in the Islands may be grouped individually and collectively as nondescripts. Many of them have long legs, wide fan-shaped tails, dark skins, and black bones, and will seldom weigh more than a kilo and usually less. They can fly like a bird, seldom lay more than eight to ten eggs, when they become broody and sit. They are but a slight, if any, improvement over the jungle fowl except that they are domesticated. They have no merits as egg-producers, as game birds, or as table birds. It is a loss of time and effort and feed to raise such chickens for any purpose whatever. It has been argued that this type of chickens are healthier than other chickens; also, that the people who raise them can not afford to raise better ones. An alibi can be established for the first contention and as for the second it is not believed that any one is poor enough to waste his time in raising such chickens.

Chickens will be discussed again under the heading of "Improved Breeds."

TURKEYS

Turkeys are very difficult to raise in any country, and particularly so in the Philippines, and that is why they command such a high price. If we could solve the problem of how to raise them more successfully we could profit by this very state of affairs and it is believed that it could be done to a considerable extent.

Fully 50 per cent of all little turkeys die before they are two months old, from the results of getting wet, either by being rained on or from running in the wet grass; also, as a result of indiscretion in feeding them. Young turkeys do better if they are not fed anything for the first 36 to 48 hours after hatching. During this time tie their mother out on the very short grass, when it is perfectly dry, and let them hunt insects and bugs only that may be found on the grass. Then in two or three days give them a very small amount of hard boiled yolk of egg, chopped very fine. It is well also to give them a little sour or clabbered milk once daily. Their feed should be along this line for at least two months, when refuse from the table like bread crumbs soaked in milk, may be given them in addition to the bugs that they can find on the dry grass. It is more or less dangerous to give rice, either cooked or uncooked, to young poultry of any kind for the first three or four months after being hatched, and after this age if you give it at all give it in the form of palay only.

It is better to set the turkey eggs under chicken hens as these make the best mothers for young turkeys. The chicken hen not only teaches the young turkeys how to feed, but is not so heavy as a turkey hen and does not tramp so many of the young turkeys to death. Again, the chicken hen may be more domestic and will stay nearer the house or other shelter where the little ones can be kept out of the rains and wet grass.

One gobbler to two turkey hens is quite sufficient, and they must be kept absolutely to themselves, away from any other gobblers, in order that the eggs may have a chance of being fertilized. If there are two or more gobblers running with the turkey hens there is little, if any, possibility of the eggs being fertile and consequently they will not hatch. It is very important to take this simple precaution if the eggs are for hatching.

The turkeys in the Islands are smaller in size than they normally are in the land of their nativity, which is believed to be due very largely to the difference in the feed, selection in breeding, environments, and the failure to bring in new blood for breeding purposes, from time to time.

DUCKS

Ducks are raised in rather large numbers near Manila, but not many are raised any considerable distance from Manila and the other larger centers of population in the Islands. There are several different breeds in the Islands, such as mallards, Indo-China, Indian runners, and muscovies, in addition to a number that do not resemble any particular breed. The Indian runners are noted for the large number of almost white shelled eggs that they lay. They are the egg-producers in the duck family comparable to the Leghorns in the chicken family and, like the Leghorn chickens, very seldom sit. The eggs must be hatched under some other kind of ducks, or a chicken hen, or in an incubator. The flesh of the Indian runner ducks is almost white and they are considered excellent table birds when properly cooked.

The muscovy ducks may be regarded as dual-purpose birds, as they are good layers and good eating. They are very prolific and the drakes are about a third larger than the females. They are often, but erroneously, called Chinese ducks. They are found in many different countries and in South America, particularly Brasil, where there are large numbers in the wild state.

One muscovy drake to two females is quite sufficient, and for all the other breeds one male to five or six females is about right.

All adult-breeding ducks should have clean fresh water to swim and feed in. They should have slugs and snails to eat in order to supply them with the necessary lime for their nutritional requirements in addition to cereals, like cracked corn or palay.

The little ducks during the first few weeks after they are hatched should be kept out of the rain and wet grass, and given sour or clabbered milk in addition to the bugs they find on the grass. They should always have all the fresh clean water that they want to drink, but no water to swim in until they are several months old.

Ducks of all kinds thrive in the Islands and it is believed that more of them could, and should, be raised.

HERD AND STUD BOOKS

Nearly, if not, all countries that make the best of their livestock industry keep a Herd Book for each breed of cattle and a Stud Book for each breed of horses. The keeping of herd and stud books enables the tracing of registered animals back for many years through the recorded pedigrees of their ancestors and are therefore valuable and indispensable records in raising improved livestock of various kinds.

If the supposition of origin is correct for the Batangas and Ilocano type of cattle, they are homogenous and first cousins and would be eligible materials for starting a Philippine Herd Book. In such an event it would be advisable to start with a few specially well-selected ones that come up to a very high standard.

Several years ago Colonel Robert Vans Agnew, Veterinary Corps, U. S. A., advocated the opening of a Stud Book for the registration of Philippine ponies possessing certain qualifications.

A Herd or Stud Book may be started by an individual, or an association of interested parties, usually breeders, for the purpose of registering ancestral records, when the animals in a particular locality have certain general characteristics which they transmit to their offspring with sufficient regularity that they may be recognized as a distinct breed.

The usefulness of such an undertaking depends upon the reliability and thoroughness of the record, or statement, that may serve as a guide in determining the blood-lines, or breeding, which may be termed a pedigree.

A pedigree is not necessarily an evidence of purity of blood, as animals of mixed blood may be eligible for registration as well as those that are full-bloods.

In one sense every living thing has a pedigree, or lineage, which may or may not be recorded, and if recorded it may be good, bad, or indifferent. With many stock breeders only such animals as measure up to a certain standard are recorded, regardless of their eligibility for registration on blood-lines.

DEFINITION OF TERMS

The term "full-blood" denotes animals of a distinct and well-defined breed, without admixture of other blood.

The terms "pure-bred" and more or less arbitrary "thorough-bred" may be used synonymously with "full-blood." However, "thorough-bred" in its strict interpretation is used to designate a running race-horse that was developed in England.

The term "standard-bred" is applied to harness race-horses, which may be either fast trotters or pacers, conforming to a certain standard for breeding, or performance, or both. There are ~~about~~ several rules under which this class of animals may be registered in the States.

The term "cross-breds" are animals produced by breeding together distinct breeds.

The term "grade" denotes the product of a cross between a full-blood and a native which, in many countries, may not be pure-bred as is often the case in the Philippines. In this article the terms "cross-breds" and "grades" may be used interchangeably in most cases, as so few of the native animals have any admixture of foreign blood excepting the first cross.

IMPROVED BREEDS

The term "highly improved breeds" implies that the animals referred to have been bred up to a very high state of physical excellence and intelligence, for the purpose intended. They are very artificial, possibly delicate in constitution, and if their breeding is not continued along a very definite direction, their special characteristics will readily become latent, or completely disappear.

Their relative value depends, to a great extent, upon their development in a special direction as in the specific types of horses, prolific milch cows, high quality beef cattle, various types of hogs, dogs, chickens, etc. Any general symmetry or proportion of form that is pleasing to the eye may be regarded by the amateur admirer as a form of beauty that is satisfactory, although it may not represent any of the qualities that render the animal valuable for any particularly useful purpose.

Contrary to popular belief the many different and highly developed domestic animals did not just happen by mere chance or accident. They may, at least some of them, have started that way. They were then built up and improved upon to their present state of physical perfection and performance, by preconceived ideas of what was desired, on the same general principles that an architect foresees the finished building that he is planning.

They were all evolved from one, or the very few, specific types of the primitive wild animals of their kind, to meet certain and exacting requirements of man's ever increasing necessities.

All of them are of more recent origin than their primitive ancestors and, consequently, their potency is not so permanent or fixed, which explains why there is occasionally a reversion in them to some ancestral type. This is known as atavism and in more common terms as a "throw-back."

Miles, whose statements on stock breeding applicable to local conditions have been freely quoted in this article, either verbatim or with modifications, says: "The successful breeding of highly improved animals is an art." To which might be added, "not alone for art's sake, but for the sake of the necessities of a modern civilization and the consequential pecuniary rewards resulting therefrom."

Some of the milking breeds of cattle have been so perfected that occasionally one may give 20 or more liters of milk in a day, and give milk from 11 to 12 months in a year. The primitive wild cow would never give any more than enough milk to barely subsist her offspring, and then only for a few months in a year. Nature did not encumber her with a large udder necessary to give a large flow of milk, for it would be unnecessary and a handicap to her in defending herself from her enemies. While some breeds have gained in physical attainments, like the highly developed milch cow, others have lost in physical endowments, like the several types of polled, or hornless, breeds, as no type of wild cattle have ever been known to be hornless. The first hornless bull, so far as known, was produced in Paraguay, in 1770, and was probably the progenitor of all other hornless breeds—an interesting phase of the mutation theory of heredity.

Some of the highly developed egg-producing chickens will lay as many as 300 eggs or more in a year, while their primitive progenitors may not have laid more than six to eight eggs.

Other types have been evolved from the jungle fowl that are noted for their egg-laying abilities as well as for the quality and quantity of their flesh.

There are a number of types of the many different breeds of domestic animals to meet every requirement that can possibly be expected from animals of their kind. Consequently there is no necessity of trying to build up new types, nor can this be accomplished within the lifetime of any individual as it requires many years to build up and fix a potent type. Some of the well-established breeds of animals have required from 500 to 2,000 years to arrive at their present state of perfection and, as above stated, their breeding should continue along in a very definite direction and not by haphazard breeding with first one kind of an animal and then with another.

The breeding animals imported into the Islands from time to time are potentially an asset or a liability, depending firstly on whether or not they will live and thrive and, secondly, whether or not they are properly utilized for the purposes intended.

It is a well-known and accepted fact that there are comparatively few animals or plants that will survive for long, and much less thrive, if transplanted very far from their natural geographic distribution. To attempt to transplant them is not only expensive, but exceedingly hazardous, and it requires intelligent management and considerable time to fairly test them out.

The Bureau of Agriculture has been importing breeding animals with the view to improving the livestock industry in these Islands for a number of years. Some of the experiments have prospered and some have not for reasons that may or may not have been controllable. The pioneering in this kind of work can best be done by the Government through its highly organized and more or less efficient machinery and, if found to be successful, private parties may be encouraged to take up and continue the work from this point. As is to be expected some people make a success while others make a complete failure of it. The greatest difficulty has been to convince people who have acquired one of the imported type of animals of the advisability of staying on one road.

The general tendency for domestic animals, particularly mammalian, when removed any considerable distance from their natural environments, is to degenerate in size, and that very markedly and quickly. To obviate this, new blood in the way

of pure-blood males of the same breed should be imported from time to time for breeding purposes in order to keep the animals up to a certain standard.

For various reasons it would be too impractical and even inadvisable to import both sexes of expensive experimental breeding animals. So pure-bred males are imported to mate with native females of their kind. This is believed to be the best procedure to follow in building up a herd in most cases. The system is promising, in some instances, and may be considered as successful, providing the follow-up system of breeding is properly continued.

In building up, for instance, a milking strain from native animals as foundation stock by mating particularly well-selected high-caste native cows with a pure-blood Ayrshire bull for four or five generations a reasonbly fair milch cow could be expected as a result, and the longer the system is continued the better and more productive the type of milking cow that could be developed. In order to do this, the sire is mated to his daughters, for one or more generations. This is known as in-breeding in contradiction to line-breeding. In in-breeding, animals with 50 per cent, or more, of the same blood are mated. This system may, and frequently does, give the maximum success in livestock breeding. On the other hand, the defects may, in some cases, be greatly magnified and, therefore, result in a complete failure. Line-breeding implies the mating of animals of the same breed and type but not so close-up in blood relation as in in-breeding.

If by mating a full-blood Ayrshire bull with specially selected high-caste native cows a man succeeds in getting a crop of 25 to 40 calves, and one-half of them heifer calves, the bull will have paid for himself; provided, the follow-up system is continued by either breeding the heifer calves, when they become old enough, to their sire or to another full-blood bull of the same breed. This method must be continued to the fourth generation in order to get, theoretically, full-blood cattle of any special breed or type. However, the type is not then sufficiently fixed to be prepotent, that is, capable of transmitting their physical characteristics to their offspring, in all instances, which may also be termed the law of similarity. The longer they are bred along this line, either by in-breeding or by line-breeding, the more prepotent, or fixed, the type becomes.

All grade or cross-bred male herbivorous animals, as horses, cattle, sheep, and goats should be castrated, or slaughtered,

before they reach the age of puberty, or otherwise prevented from reproducing their kind, as they are not sufficiently prepotent to transmit their similarity to their progeny.

A very simple yet practical way for a livestock breeder to build up his herd or flock would be to get pictures of prize-winning animals of both sexes, that he hopes to raise and have them framed and hung in his house. Then he should make it a point that every generation of animals that he raises must look more and more like the pictures hanging on the wall. This is best done by retaining for breeding purposes only the animals that most resemble the pictures and weeding out and disposing of all the others. It does not pay to keep an animal that does not look as if it had a future. People who have become internationally known as high-class livestock breeders dispose of many animals and keep but a comparatively few for breeding purposes. At the present time this policy would be applicable here for the small animal and poultry breeders.

CHICKENS (IMPROVED BREEDS)

The most frequent question asked by people who contemplate raising improved breeds of chickens is: "What breed is the best to raise?" It all depends upon circumstances: whether or not the desired breed is available and what the chickens are wanted for. Some of the principal breeds for certain specific purposes will be suggested:

FOR EGG-PRODUCTION

Leghorns, Minorcas, Anconas, Campines, Hamburgs, Black Spanish, Honduras, and English Red Caps.

FOR GENERAL OR DUAL-PURPOSE

Plymouth Rocks, Rhode Island Reds, Orpingtons, Cantonese, Wyandottes, and Javas.

EXTRA LARGE CHICKENS

Brahmas, Cochins, Langshans, and Jersey Black Giants.

FOR ORNAMENTAL PURPOSES ONLY

Phoenix (long-tailed Yokohama cock), Silkies, Frizzles, Bearded Silver Polish, Araucanas, Sultans, and Bantams.

A few of the above breeds are available locally. Ordinarily the breeds noted for the large number of eggs that they lay are nonsitters, and their eggs must, of necessity, be incubated under other chickens or in incubators. There is an old proverb that says: *A setting hen lays no eggs.*

The same general principles will apply to the raising of any of the breeds by culling out the inferior birds, of both sexes, and disposing of all the surplus roosters before they reach the age of puberty, keeping but one rooster for every eight to ten hens and he the best one that it is possible to obtain. It is also absolutely necessary to keep them separated from the neighbors' chickens in order to keep them clear of undesirable company.

A party living in Manila who was well situated, by being thoroughly isolated from the neighbors' visiting chickens, bought a native hen in the public market for table use. He decided not to use her at the time and turned her loose in the grass-covered yard. In a few days she began to lay eggs and after having laid a few, set. He bought a setting of White Leghorn eggs, from good birds, for ₱3 and set them under the hen. From this setting he succeeded in raising seven chickens which he sold just before they were old enough to begin laying for ₱5 each, or ₱35 for the seven. In the meantime the hen had laid a few more eggs and had begun sitting again. This time he bought a setting of Rhode Island Red eggs for ₱3 and again set the hen. This time he succeeded in raising but two chickens—one cockerel and one pullet. The next time the hen set he again set her with Rhode Island Red eggs and succeeded in raising seven chickens, making a total of nine Rhode Island Red chickens that cost all told ₱6. In about 11 months the young pullets were laying eggs. From this time on the flock increased in number quite rapidly. He kept killing the young inferior cockerels for table use before they arrived at the age of puberty. A few of the better ones he sold, but kept the very best ones for his own use. As the flock increased he kept culling out the inferior ones, of both sexes, and either eating or selling them. In about three years circumstances forced him to dispose of his chickens, which he did, selling all of them for ₱124. In the meantime he had sold about ₱80 worth of eggs and chickens, besides what he used for his own table. This left a total cash profit of ₱230 in three years' time on an investment of ₱9. This would indicate that there is at least profit, and possibly pleasure, in raising good poultry if done in the right way. His flock of poultry was admired by every poultry fancier that saw them. He was frequently offered very fancy prices for his best birds but he would not sell them—and that was the secret of his success, which general principles will hold more or less true in raising any kind of livestock.

It is not imperative that a livestock breeder, of any kind, have either a veterinary degree or an animal husbandry degree or any other academic degree. The former implies that the holder is skilled in treating diseases of animals and the second that the holder is skilled as an animal economist, although a certain amount of knowledge pertaining to the subject may be inherent, or acquired. The two professions are an outgrowth, and not the producers, of the highly improved breeds of livestock.

The most successful breeder of running horses, also known as "blooded horses," is a woman who succeeded her deceased husband in managing one of the finest livestock farms of its kind. She bred and raised "Man o' War" the fastest running horse that the world has ever produced. Another woman, living in the same State, who owns a fine livestock farm, bred, raised, and raced two standard-bred horses that held the world's record for pole-team pacers, until they both perished in a fire. Many other instances could be cited of women making a success in the livestock business.

Many women in the Philippines are interested in small animals, particularly chickens and pigs. There is no reason why they could not make a success of it especially in raising improved breeds of chickens, provided they got started right and stay on the right road.

In building up a herd or flock to a high standard of quality, either of native animals by careful and intelligent selection in mating, generation after generation, or by using them as foundation stock and upgrading to an improved breed, or by maintaining the quality and possibly improving the excellence of an already improved breed, it is very important and absolutely necessary that they be kept isolated from other animals of their kind. It is also necessary that they be given an abundance of appropriate feed first, last, and all the time to insure proper development and production.

MANAGEMENT

Management implies the practical application of the general principles advocated throughout this article, the details varying according to the circumstances.

There have been two general plans suggested for raising cattle. First, for a person starting in the cattle-raising industry in a modest way, or already in it, to improve the quality of his herd, i. e., by keeping but one bull for 20 to 40 cows, and he to be the best animal in size and conformation, of the partic-

ular type, that it is possible to obtain. Castrate all other bulls before they reach the age of puberty, preferably before they are three months of age. The sooner the better. This precaution prevents the steer from developing the stag characteristics and adds to the quality of its flesh for meat.

Reduce the number in the herd, to conform with the available pasture, by weeding out all inferior animals, of both sexes, and thereby assuring more feed for those that are retained.

Build the necessary sheds, for shelter, surrounding them with a strong corral fence, for the purpose of corralling the herd each evening whereby they can be kept docile, inspected, branded, salted, castrated, vaccinated, their wounds treated, etc., etc.

The second plan is a more costly one but on the same general principles, plus the fencing of the range or farm with boundary fences and, preferably, cross-fencing in order to divide it into several different pastures. Permit the bull to run with the cows but three months in the year, depending upon locality, as to the particular time. This with a view to having all the calves born during the most favorable season of the year, and moreover, all of them about the same size. Wean the calves when they are seven or eight months of age, and separate them from their mothers, in order to give the cows a rest before the next calving time.

Close observance and practice of these general principles generation after generation would make a wonderful improvement in the size and quality of native cattle within two or three generations.

The third plan, now being suggested, is the most costly one of all. It is the one proposed for the crossing of native cattle with one of the highly improved breeds as the beef or dairy types. It requires more technical knowledge and familiarity with livestock breeding and therefore close personal attention to details. It is not recommended for the average livestockman having but limited funds and little or no knowledge of livestock breeding.

If it is the intention to try and build up a superior type of cattle either of the beef or of the milking strain by crossing a highly improved bull with native cows, as foundation stock, in order to improve them in quality, for the purposes intended, generation after generation, and at the same time accustom the offspring to live on the country, it would be advisable to keep the bull up all the time and feed him. The preferable

feed would be that to which he is accustomed in the land of his nativity, such as red clover or alfalfa hay and wheat bran, in addition to a liberal amount of upland green forage that may be available in the particular locality. Or as a substitute you may give him one of the feeds or rations suggested under the heading of Feeds and Acclimation, or Dairying. This with the object in view of keeping him vigorous and in good physical condition.

In order to do this it would be necessary to construct a sufficiently large and strong corral around the shed or shelter, and corral the breeding cows every night as in the case of Ranch Plans No. 1 and 2.

Then build a special box stall about 9 $\times$ 9 feet under the shed in which to keep the bull. The box stall should have a manger in it set up at the proper height for the animal's feed. During the breeding season turn the bull loose at night with the cows inside of the main corral, and during the day time when the cows are out to pasture let him run loose inside of the large corral for exercise.

Between the breeding seasons keep him inside of his special box stall at night only, when the cows are in the main corral. During the daytime when the cows are out to pasture turn him loose inside of the large corral in order that he may get sufficient exercise. This means that if there is no water inside of the corral he would have to be watered every day two or three times, in addition to being fed.

Castrate every one of his male calves, if beef animals, by the time they are three months of age, for there is not one of them that will be good enough to keep for breeding purposes no matter how good they may look. If a dairy breed of bull calves it would be advisable to slaughter every one of them, for veal, just as soon as their navels are dry, which is generally when they are from three to four weeks of age. This is the age for the best veal and such calves never would make good beef steers if castrated and permitted to grow to maturity, and a cross-bred dairy bull never would be good enough to retain for breeding purposes.

The cross-bred heifers, or herbivorous animals of any kind, may be mated to their sire if he is still alive; otherwise to another full-blood animal of the very best quality that it is possible to obtain of the same breed. Keep this up generation after generation and by the time four crosses, preferably more,

have been produced there should be a fairly good type of the particular breed and, quite possibly, one that may live on the country. This is understood as suiting an animal to the land, as well as a short-cut method of grading up a particular type of an animal. If a cow of the imported dairy type produces a calf from a pure-bred sire of her kind, it would be advisable to let the calf have all the milk that it wants, in order to give it every possible chance to develop into a strong and vigorous animal of its kind. Then, if there is any surplus milk, it could be utilized for other purposes. But the most essential thing to do in getting a start of the improved breeds is to favor the offspring in every possible way, and thereby overcome, as far as possible, the many handicaps it must undergo under adverse conditions before it reaches maturity.

When the calf is old enough to eat it should be given a liberal amount of locally grown grass and some imported, or substitute local grain concentrates, in addition to all the milk it wants. The substitution of any other kind of food for the mother's milk will stunt the growth of the calf so it will never recover and is, therefore, not an economic advisability.

It is not unusual for a cattle raiser to purchase, for instance, an Indian bull and turn him loose with a herd of cows that have native bulls with them. In such a case it is the exception, and not the rule, that the Indian bull will ever sire a calf. Invariably he will leave the herd and stay by himself. He has the advantage, however, of being able to subsist on the grasses that are indigenous to the country.

If instead of an Indian bull an improved beef, or dairy type, bull is substituted under similar conditions the results are very frequently worse, for he will rarely live for any length of time on the grass of the country and will die of malnutrition or some intercurrent affection without siring a calf.

This is an explanation of why the livestock raisers are so frequently and bitterly disappointed in purchasing expensive bulls for the purpose of improving their herds.

The results would be much different if they would practise either the No. 1 or No. 2 Ranch Plan suggested in this article if using Indian bulls, and if using the improved breeds, as beef or dairy, adopt Ranch Plan No. 3. It is understood that there shall be no other kind of bulls with the herd at any time. This is imperative to assure success.

In the "Cattle of the World" number of the *National Geographic Magazine*, 1926, Alvin Howard Sanders, D. Agr., LL.D., editor of *The Breeders' Gazette*, and author of several books pertaining to livestock, says:

It is not altogether sufficient as a breeding proposition that an animal be good in its own conformation. Its goodness may be a mere matter of chance; and while this may be satisfying enough, so far as the animal's own presence in a herd is concerned, chance excellence is not a dependable kind of merit when it comes to reproduction.

Great is the power of reversion; by which is meant the innate tendency to hark back to forbears perhaps forgotten. That is why the wise breeder insists upon *inherited* individual excellence. It must have been a transmitted possession or it will prove a vain, an illusive thing. For this reason it is never advisable to use a "mongrel" as a sire; none but pure-bred bulls should be employed for service in any case.

The mating of a pure-bred bull with ordinary native or unimproved cattle is the short cut to improvement. The very first crop of calves from the good, pure-bred sire should be twice as good as their dams.

Any farmer is foolish who works with miserable, unimproved cattle, for the road to a vast betterment is so short, so easily accessible, that there is no excuse for not making a start in the right direction.

The progeny of a pure-bred bull from a non-recordable dam is technically known as a "grade," i. e., "part-bred." These often look almost like the pure-breds and usually are practically useful, either in the working dairy or the feedlot; but a male so bred should in no case be chosen for stock-getting purposes. He cannot be depended upon to transmit his own possible excellence, for reasons previously stated. The purchase and use, therefore, of a "grade" bull merely because he may be bought for less than the price of a pure-bred is a decidedly expensive kind of "economy."

FEEDS AND ACCLIMATION

When discussing the possibilities of an animal living in a country foreign to its nativity, the question of acclimation is invariably referred to. The feed is seldom, if ever, considered, yet, in the opinion of the writer, it is by far the most important question of the two for all herbivorous animals. There are many telling facts in support of this statement; a few only will be related.

For many years horses, mules, and cattle have been imported into the Philippine Islands from the States, Australia, and China, principally. Many of the horses and mules were brought in by the military authorities; many by the Insular Government; many by the City of Manila, and many by private parties.

As a general rule all the horses and mules that were fed imported feed common to their native land have fared as

well from a physical standpoint and have given as long, if not longer, general average service than if they had been in their native countries and employed in the same kind of work as in the Islands.

If for some reason, through change of ownership, or otherwise, these animals are fed exclusively on locally grown feeds, *containing no grain like palay or corn,* they invariably go from bad to worse and within a comparatively short time become complete physical wrecks, though they may have been in splendid physical condition at the start.

Native ponies, if fed on imported feed for several years, and in splendid physical condition, will, if turned out on local grass, actually starve to death and that within a comparatively short time; notwithstanding the fact that they may have been in condition to be worked hard every day and were fat, fresh and fit before being turned out to grass.

A large number of American, Australian, and Philippine horses, as well as mules from the States, Australia, and China have given as many as 15, or more, years of the hardest kind of service to the City of Manila. One Australian horse was 30 years old, and still in very good physical condition, when it had to be destroyed for surra. Another Australian horse was 27 years old when it developed pneumonia and died. A large number were from 20 to 25 years old before they were condemned and destroyed—generally for the reason that they had become defective in their feet or legs, though they were "hog fat" and in splendid condition bodily, after having worked hard every day.

For general average serviceability the horses and mules that were in the City Stables in Manila would have compared favorably with those of any other city in the world for similar work.

The animals were fed either timothy or alfalfa hay and oats, and given a little salt once a week, and nothing else.

The daily amount for the different kinds of animals varied as follows:

Kind of animal	Timothy or alfalfa hay	Oats
	Kilos	*Kilos*
American or Australian draft horse	8	6
American or Australian light horse	6	5
American or Australian, or Chinese, mule	5	5
Philippine pony	4	3

They were, as a rule, fed three times daily and always given water before feeding—never just after feeding. Although there were a large number of them and of different kinds in the City Stables, digestive disturbances among them were very uncommon.

These rations were ample and sufficient and were never exceeded in allowance and at the end of the month there was invariably a surplus on hand, due to the fact that if an animal did not eat its allowance it was not fed so liberally at the next feeding, and hence the accumulation of feed over the prescribed amount at the end of the month.

Their splendid physical condition was frequently and favorably commented upon by admirers of good horses and particularly round-the-world tourists who, on passing the animals on the streets, would frequently point them out, or possibly stop their automobiles and get out to pet them.

The rations for the horses, as given, cost *less money* than the local liverymen were paying to try and subsist similar animals on feeds produced locally. A comparison in the physical condition of the animals spoke louder than any possible words as to the relative merits of the feeds.

Good timothy hay and oats is the choice feed par excellence for working horses, and green grass is not a necessity.

Good oat hay, also known as oaten hay, with some additional oats, is also excellent feed for horses. To make good oat hay, the oats should be cut when the grain is in the "milk" stage, and the straw is beginning to turn yellow, and then thoroughly sun-cured. It is fed with the oats in the straw. A fair substitute for oat hay may be obtained by feeding Australian fodder, purchasable locally, which consists of oat straw chopped fine and then baled. This may be fed with either oats or palay added, either dry or in a mash.

A substitute for timothy or alfalfa hay and oats as forage allowance, for the Insular Government, or for the City of Manila owned horses contained in Executive Order No. 20 is as follows:

Kind of animal	Rice hay	Palay
	Kilos	*Kilos*
American or Australian draft horse	4	5
American or Australian light horse	4	5
American, Australian, or Chinese, mule	4	5
Philippine pony (if working hard)	3	3

or

Kind of animal	Cut-feed	Grass		Corn	Chopped straw
	Kilos	*Kilos*		*Kilos*	*Kilos*
American or Australian draft horse	4 and	13	or	4	and 4
American or Australian light horse	4 and	13		4	and 4
American, Australian, or Chinese, mule	4 and	13		4	and 4
Philippine pony	3 and	10		2	and 2

By rice hay is meant rice that has been cut when the grain is in the milk stage and the straw just turning yellow, exactly the same as for oat hay. The difficulty with rice hay is to get it cut and cured when it is in just the right stage. If it is cut a little on the ripe side the grain will fall out when the straw is being handled, and if cut a little on the green side it will quickly rot. Again, to be cured properly it should not get wet either by rain or night dews, during this time. It would probably be better to feed bright sweet rice straw chopped fine for bulk, and add the palay.

By cut-feed or chopped straw is meant chopped oat straw—just what an animal will eat and experience should soon teach that—to which an ordinary size milk-tin full of palay is added, and this fed either dry or in a mash three times daily if the animal is working hard. Otherwise twice a day will do very nicely.

Several years ago a party was stationed in one of the provinces, and was allowed the regulation amount for the keep of a riding pony. He bought a good type grass-fed pony for ₱80 and rode it hard, but with discretion, for about 20 months, and was then ordered to another station. He sold the pony, as a quick sale, for ₱150. From the regulation allowance for keep, after all bills were paid, he had a surplus of about ₱5 per month for 20 months—making a total profit of about ₱170 on an ₱80 investment within 20 months. In addition he had the satisfaction of riding a pony that was in good physical condition, with sufficient stamina to do a hard day's work and finish strong.

His assistant bought a pony for riding purposes and fed and used it in the same way, and could have done just as well on his investment had he wished to sell his pony, which he did not as he was not changing stations.

Chopped oat straw would cost more today than at that time, but not much more; and palay costs about the same now as at that time.

It used to be nothing unusual for people to ask permission to place their ponies in the City Stables and let the city work them for their keep. Some of the people were accommodated and their ponies doubled and even trebled in value within one year, though they were worked hard every day on the streets of Manila. They were fed timothy hay and oats—nothing else—and the feed cost less money than it was costing many local liverymen to try and subsist their ponies on a hodge-podge ration. Many of their ponies were physical wrecks from want of proper feed.

The great majority of the ponies that we see every day in Manila and throughout the Islands are improperly fed and, therefore, lack condition. Yet they may be costing their owners as much, or even more, to feed them as they are than if they were receiving the proper kind of feed. All horses, when working, should have some grain of some kind to eat—preferably oats, palay, or corn (cracked) in the order given. Grain is absolutely necessary for a proper diet as it contains certain food elements that are not present in any other kind of feed. Horses cannot digest a large variety of foods, sometimes called a hodge-podge diet, with possibly none of the feed containing the essential food elements or nutrients, the physiologists tell us. It is much better to give them a very few varieties of feed and that these should be properly balanced in energy-yielding substancs, like some kind of a roughage, such as hay, chopped oat straw, or a cultivated grass, and a grain concentrate like oats, palay, or corn (if Philippine it is of the flint variety, and very hard, so should be cracked before being fed to the animals), and nothing else.

The question of feeding animals properly is an economic one. It is an exception for any one to lose money as a result of taking good care of and feeding his animals properly. On the other hand, the road is strewn with financial wrecks who have tried to make the grade by over-working and under-feeding their animals. It just cannot be done, yet people have been trying it since time immemorial. About the time that it begins to look good—on paper—the animals begin to die and can be written off as assets.

Oriental cattle, which term includes Philippine, Indian, Chinese, and Indo-Chinese, will live on the country. Give them half a chance and they will do very well if the grazing areas are not overstocked and the animals are getting sufficient grass. There are about three animals grazing in some localities where there should be but one. The pastures will not carry so many

and subsist them properly. As a result the quality of the animals is degenerating every year due to insufficient feed and indiscriminate mating of inferior animals of both sexes. Overstocking the pastures also prevents the grass from re-seeding the land and consequently the pastures are becoming poorer and poorer year after year.

It would be much better to get rid of the inferior animals and reduce the size of the herd numerically and build them up in quality, which would soon include quantity in the way of larger animals that would not eat any more than the scrub animals. In other words, it would be better to raise better animals and not so many of them as thereby people could make as much if not considerably more money.

It would be advisable for people who have the land to plant several varieties of the perennial upland forage crops like Napier grass, Sudan grass, Japanese cane or millet, or guinea grass. Not with the expectation of feeding a herd of grazing cattle, but to feed working animals, or those that are sick, or dairy or breeding animals that are kept up. These grasses would also come in handy to feed riding or driving ponies in lieu of chopped oat straw, in addition to the usual amount of palay or cracked corn usually given with the chopped oat straw (Australian fodder). Furthermore it would provide excellent green feed for working carabaos in addition to tiqui-tiqui and good rice straw chopped fine to give body.

A start in any of these valuable green forage crops may be obtained free of charge from the Bureau of Agriculture, Manila, or possibly from the Bureau's provincial nursery in your province.

It is believed that many carabaos die prematurely every year in certain sugar-producing sections in the Islands from malnutrition, either directly or indirectly. Many of the animals are infected with surra and are worked hard during the plowing, planting, and cultivating season for sugar cane. At this season of the year there is practically nothing for the animals to eat, as the land is nearly all planted to cane. Again, an animal that works hard during the day should have its rest at night and not be compelled to forage around all night in order to try to find a little something to eat.

A carabao affected with surra, that is in good physical condition otherwise, will frequently recover within three to four months if it is not worked hard, and is fed well, in the meantime.

It would be to the interest of sugar planters to provide themselves with a microscope and have their animals examined from time to time for surra. Nearly any reasonably apt layman can be taught in a short time how to set up a microscope and examine for surra, and recognize the organism that causes the disease when he sees it. The Bureau's veterinarian stationed in your province will teach your man how to do the work if he is requested to do so.

Cattle of the highly improved breeds that have been imported for breeding purposes and have been kept up, or stabled, and fed suitable feeds, have also done well. Nearly all of those that were turned out to subsist exclusively on local pastures have quickly become pitiful looking physical wrecks and, sooner or later, died of malnutrition or some intercurrent affection largely attributable to the poor physical condition.

Nearly all temperate zone horses and cattle that are kept up, or stabled, and fed exclusively on locally grown feeds, *with no grain of any kind,* go the same way as those that are turned out to pasture, but it takes them a little longer to do so.

The old saying has it that, "What is food for one man is poison for another." It should also include, "What is food for a man today may be poison for him tomorrow" (as in a carbohydrate diet and diabetes mellitus).

One of the objects in importing highly improved breeding stock and crossing them with native animals of their kind, that will live on the country, as foundation stock, is to try and develop certain desirable qualities that are not inherent in the native animals and, at the same time, to accustom each succeeding generation of their progeny more and more to local feeds and pastures. With the continuity of this policy it is expected that in the course of time such animals will be able to subsist, as do native animals, on the country and at the same time retain to a greater or less extent their desirable qualities, as dairy or beef animals: in other words, that what is poison for these animals today will be sustaining food for them tomorrow.

DAIRYING

Has been followed on a small scale in Manila and some of the other large centers of population in the Islands for many years. The animals used very largely for the purpose are cows imported from Australia and India and, to a less extent, native carabaos and goats. A certain class of patrons prefer cows' milk to that of either carabaos or goats notwithstanding the

fact that the milk from these animals may be perfectly wholesome.

Imported cows are very expensive by the time they arrive in Manila and importers frequently buy their cows on orders, without previous inspection of the animals themselves or having them inspected, before purchase, by a competent representative. They must, therefore, accept the cows upon arrival in Manila as they are. Consequently they must, of necessity, accept cows that are not good dairy types and never will be paying dairy animals. The longer they keep them the more expensive and, consequently, the more losing a proposition they become.

It does not pay to keep animals that have no present nor future possibilities, the best authorities tell us, which is borne out by actual observations. It would be much more profitable to send such animals to the butcher at once and recover as much money as possible on them and pocket the loss, rather than keep them indefinitely as a losing proposition. Then give those that are promising the very best feed that it is possible to obtain when they are giving milk. When they are not giving milk the feed could be reduced considerably without endangering their future usefulness as dairy cows.

The average profitable life of a dairy cow is comparatively short, and the successful dairyman recognizes the fact that he must "make hay while the sun shines." Nothing pleases him so much as to see his cows eat, and he is perfectly willing to feed the milk-producing machine with the best milk-producing food, that it is possible to obtain, provided he can get his money back with dividends. Experience has convinced him that the secret in successful dairying is to keep culling out the unprofitable animals and pampering those that are retained to the fullest extent with good feed, for greater milk production.

The very best feed available locally for dairy cows is either alfalfa or timothy hay as roughage, and wheat bran to which a small amount of crushed corn is added at feeding time as concentrates, in addition to a liberal amount of cultivated upland green forage that may be raised in the locality.

If the City of Manila could import similar feed for its horses, and obtain it much cheaper than inferior feeds could be obtained locally, and keep its animals in much better physical condition by so doing, it would seem that as a purely business proposition the dairyman might profit by this experience.

Some Filipino cattle importers in Manila import the very best of alfalfa hay for the purpose of feeding their beef cattle that are awaiting slaughter. Their reason for doing so must be that they think it pays. The loss and gain statement is apparently their guiding star, rather than prejudice and sentiment.

Recently we have had two distinguished visitors in Manila who have told us, through the local papers, that we do not use a sufficient amount of fresh milk for our health. One of the visitors in question (Dr. Victor G. Heiser) is known internationally as a medical authority, and was one time Director of the then Bureau of Health in these Islands. McCollum, who startled the scientific world when he discovered those somethings that he called vitamins which are so essential to our nutrition, says that they are all present in fresh milk. The presence of all the vitamins in one article of diet that is used almost daily may explain, very largely, the wonderful physical development of certain races of people, as with many of the East Indians and their general use of goats' milk. Certain large leaf vegetables are also rich in certain vitamins but they are not always available and would, for most people, have to be supplemented with animal proteins, as meat or eggs. Cod liver oil is also rich in vitamins, but who wants to take it in preference to fresh wholesome milk?

It would not be possible for the great majority of rural people to keep milch cows, nor even carabaos, but many of them could find the means, if they so desired, to own a few goats of the better milking types. The animals do not cost much to begin with, nor much to keep, and their milk is considered to be of good quality and perfectly wholesome.

In the feeding of herbivorous animals we are but passively interested in vitamins, but we are much concerned with certain mineral salts which will be discussed later on.

SILOS

The subject of dairying is inseparable from that of silos, which are used extensively in some dairy countries for the preservation of succulent forage, against such time as it is not available, as in cold countries in which green feed cannot be had at certain seasons of the year. The silage can never be any better than was the green forage at the time it was put in the silo; and the advisability of constructing a silo would depend much on individual circumstances. In a country in which green forage can be produced the year round, by irrigation or otherwise,

this could be fed direct and thereby save the expenses of building a silo and the labor costs of putting it in the silo and taking it out again to feed the animals. Such a process would not improve the quality of the feed one iota. On the other hand, there may be a considerable loss in spoilt and damaged feeds—estimated by Eckles to be at least 10 per cent. Again, silage is not a complete ration in itself, for dairy cows. It would have to be supplemented with other feeds like grains (concentrates).

A substitute dairy-cow ration that is used by some dairymen in and around Manila is about as follows:

RATION NO. 1.—*Daily ration for one cow*

	Kilos
Alfalfa hay	6
Concentrates	4
Grass green (paddy) bundles large	5

In the "concentrates" for ration No. 1 are:

	Kilos
Darac	20
Copra meal	15
Corn, cracked	2
Wheat bran	3

The nutritive ratio of this ration is said to be about 1:8.8 in the proportion in which it is given. It was found to be unsatisfactory by the people who were using it, it is said, and its further use was discontinued.

RATION NO. 2.—*Daily ration for one cow, divided equally into a morning and evening feed*

	Kilos
Timothy hay	2
Alfalfa hay	2
Timothy fodder (probably chopped oat straw)	2
Mixed feed	1½
and	
Green forage	8

The green forage consists of grass and leguminous plants (utao and manimanian) to be fed as a midday feed.

The mixed feed consists of:

	Parts
Tiqui-tiqui	10
Binlid	3
Ground yellow corn	1
Ground mongo	2
Copra meal	2
Wheat bran	2
Oats	2

The nutritive ratio in this ration is estimated to be about 1: 7.6 and is considered a slightly wide ration. The amount of mixed feed in the ration should be increased for every corresponding increase in the milk yield of each cow; it is said.

There are other dairymen in and around Manila who possibly feed different feeds or similar feeds in different proportions.

We may be amazed at the variety of components prescribed in animal dietetics and confused with the terms narrow and wide rations, which are so frequently employed, and we are at a disadvantage if we do not understand them.

Briefly stated a narrow ration is one in which the proportion of carbohydrates and fats to protein is about one to five or less, i. e., one stands for the amount of protein and five for the amount of carbohydrates and fats.

A wide ration is one in which the ratio of protein is about one to nine of carbohydrates and fats or more.

This would mean that a balanced ration would lie somewhere between these two, usually about one to six or seven for working horses.

The definitions given by Henry and Morrison in Feeds and Feeding, for the various terms used in food digestion, are about as follows:

Nutrients.—The term *nutrient* is applied to any food constituent, or group of food constituents, of the same general chemical composition, that may aid in the support of animal life. Crude protein, the carbohydrates, and fats constitute the generally recognized primary classes of nutrients, altho air, water, and mineral matter might likewise be so termed.

The term *digestible nutrient* covers that portion of each nutrient which is digested and taken into the body, as determined by digestion trials with various mature animals.

A *ration* is the feed allowed or set apart to maintain a given animal during a day of 24 hours, whether all thereof is administered or fed at one time or in portions at different times.

A *balanced ration* is the feed or combination of feeds furnishing the several nutrients—crude protein, carbohydrates, and fat—in such proportion and amount as will properly and without excess of any nutrient nourish a given animal for 24 hours.

A *maintenance ration* is one that furnishes enough, but no more, of each and all of the several nutrients than is required to maintain a given resting animal, so that it will neither gain nor lose in weight.

These definitions are more or less comprehensible until we begin to inquire into the nature and digestion of crude protein, carbohydrates, fats, cellulose, and minerals, when the question becomes extremely complicated.

In perusing Smith's Manual of Veterinary Physiology, which is frequently quoted in this article, the words protein, carbohydrates, fats, cellulose, and mineral salts are used here and there. In hitching up this with that we arrive at the general conclusion that they are the principal elements in every kind of food, both animal and vegetable, no matter whether it comes from the land or from the sea, and for every kind of animal whether it lives in the trees, in the water, or on the land.

If these conclusions are correct, why would it not be possible for every kind of animal to live on the same kind of food? The answer might be that they could, provided that the nutrients in the food were in such a form that they could be utilized by the various kinds of animals.

According to the physiologist every kind of food, no matter what kind, must be split to pieces and reduced to its simplest elements before it can be utilized, and reconstructed into the body requirements by Nature's marvelous laboratory that exists in every living thing. The process is an exceedingly complex one which may be understood, imperfectly understood, or entirely unknown. In a dog that eats meat and reconstructs it into meat, the process would not appear to be so complicated as it is in a cow that eats grass and converts it into milk or meat—entirely different substances. No laboratory has ever been constructed by human hands that has succeeded in performing such a feat.

In an article of this kind it is not believed that it would serve any useful purpose to attempt to enter into a general discussion of such a complex subject as digestion, absorption, and nutrition.

The term *protein* is so frequently used when discussing feeds for domestic animals that a definition of the term would seem to be necessary. Smith says that proteins are nitrogenous organic substances which form the essential basis of all animal and vegetable tissues, both fluid and solid. They are composed of nitrogen together with carbon, oxygen, hydrogen, and sulphur, in varying amounts. They are chemically of a highly complex character; their constitution is unknown.

They have also been described physically as gelatinous semitransparent substances occurring in native albumen as, for instance, in the white of an egg.

Carbohydrates form a group of non-nitrogenous organic compounds of carbon, hydrogen, and oxygen. The common term is starches, and they are a very important factor in the feeding

of animals. They exist in the animal as well as the vegetable kingdom, but are more common in the latter.

Fats are non-nitrogenous bodies derived from oil, either animal or vegetable, also from starch conversion in the food.

The term *cellulose* is also applied to a non-nitrogenous body which resembles, and is allied to, starch. It forms the cell walls of plants and thereby acts as the skeleton, analogous to the bony skeleton of animals, for the plants.

He further says that the inorganic substances found in the body are water, gases, and salts. Water forms 60 per cent of the whole body. The bulk of it is taken in with the food and water, only a small quantity being produced in the organism. The water supplied to the system furnishes no potential energy, and consequently no nutrition.

The gases are oxygen, nitrogen, hydrogen, carbon dioxide, sulphuretted hydrogen, and marsh gas. There is no solid or fluid tissue of the body free from carbon dioxide, it being the most widely distributed gas in the body.

The salts of the body are contained in every solid and fluid tissue, though not always in the same proportion. In bone it is naturally high. The salts found are those of sodium, potassium, calcium (lime), magnesium, and iron, in the form of chlorides, sulphates, phosphates, and carbonates. The nature of the diet influences the character of the salts present—for example, vegetable food is rich in salts of potassium and poor in those of sodium. The salts contribute no energy to the body, but their function in nutrition is of the utmost moment, as they direct in some unknown way the metabolism of the body.

There is little, if any, absorption of foods from the stomach of any animal, as it takes place from the intestines almost exclusively. The water that is drunk goes direct to the cæcum, which functions as a water reservoir and for the digestion of cellulose, in conjunction with the double colon. The horse has a very small stomach and if watered soon after being fed the contents are prematurely flushed out into the intestines before they have been properly acted upon by the gastric (stomach) juices and, thereby, frequently cause intestinal disturbances commonly known as colic.

The horse will hold his own in absorbing proteins with any other herbivorous animal but compares unfavorably with ruminating animals (those having four compartments to their stomachs) in absorption of carbohydrates and fats.

A deficiency of the above-mentioned salts is believed to be responsible for osteo-porosis, or big-head, in horses, which is quite prevalent in the Philippines as well as in many other countries.

Too little of these salts is also believed to be responsible for a certain nutritional disease in cattle known as osteomalacia and in South Africa a similar, if not identical, disease known as lamziekte, and in Queensland as the bone-chewing disease. In the States hogs, especially fat ones, are frequently affected with a posterior paralysis when not getting a sufficient amount of the minerals.

The theory is now being advanced in some quarters that the stunted growth in cattle, having a disproportionate development of the front quarters to the hind quarters, is due to a deficiency of these mineral salts.

The mineral salts in question are normally contained in the food itself, and in this form they are more assimilable than if they are supplied in the inorganic form artificially. Raw freshbone meal given in the feed greatly lessens the tendency to certain nutritional affections in cattle and hogs.

It is believed that it would be to the best interest of every livestock breeder to have some knowledge of the diseases that are more or less prevalent in the Islands.

For obvious reasons it would be quite impossible to go into minute details in discussing such highly technical and complicated subjects as diseases, in an article of this kind. The most meager and fragmentary descriptions only will be attempted with the hope that they will be of some service in cases of emergency when the services of a qualified veterinarian are not available.

Every kind of an animal, including man, has its diseases, sometimes having a monopoly on one or more of them. Thus, man has a monopoly on some of the eruptive febrile affections, like measles and scarlet fever, as well as some specific diseases, also on some addictions like those to narcotics, alcohol, and tobacco.

There are several diseases that man may contract from the lower forms of animal life, and comparatively few that animals will contract from man.

The lower forms of animals will sometimes share their diseases with other animals that are not of their kind—as rinderpest from cattle to hogs, and surra from horses to cattle or dogs or vice versa.

There are comparatively few diseases that have a mortality of 100 per cent in all cases.

There are a few diseases that have a mortality of 100 per cent in some animals, while in some other animals the mortality is very low—as surra in horses which is fatal in all cases, while comparatively few carabaos will die of it, if they are well fed and not worked hard in the meantime.

There is one disease that will affect every known terrestrial and arboreal mammal, including man, and that has a mortality of 100 per cent in every animal in which the disease develops—and that disease is RABIES.

COMMUNICABLE DISEASE

This term will be used in the sense that it is an affection capable of being imparted to another animal of the same kind, or to an animal of a very different kind, either directly or indirectly, without reference to the method of transmission. Reduced to its simplest definition it means that can be shared also imparted.

It is used in preference to the terms *contagious* and *infectious*, which may be used in very diverse senses. And many diseases would not come under the classification of either term although they may be very communicable, as insect-borne diseases (conveyed through an intermediate host).

All dangerous communicable diseases of domestic animals should be promptly reported to the proper authorities as soon as suspected.

The proper person to be informed of the presence of a suspected communicable disease in your locality is the municipal president or, if in a barrio, the lieutenant of the barrio. Then you should report the disease to the Bureau of Agriculture veterinarian in your province or, if none in your province, the Bureau's livestock inspector. If neither one is available report the case by letter to the Director of Agriculture, Manila, giving as many of the symptoms as you can. If you do not get quick action by your lieutenant of barrio, or municipal president, report the disease to your provincial governor.

This procedure is very very important and as a good citizen you should not fail to do this, and that without delay. If you are aware of any disease among animals in your locality that has not been reported to the proper authorities you should, as a matter of patriotic duty, as well as for the protection of your own animals and your neighbor's animals, report it.

In the meantime restrain the movements of the sick animal, by tying it up, or confining it in a corral, and isolate it from other animals as much as posible, and the nearer it can be done where the animal is found the better. There is danger, much danger, in permitting sick animals to run loose and in moving them from place to place.

Many big fires could be put out with a cupful of water, if properly used, at the very beginning. Just so in the very beginning of many destructive diseases they could so promptly be "put out" if early and proper measures were efficiently used. Many diseases owe their existence to indifference and procrastination.

DISEASE AFFECTING MAMMALS

RABIES

Every mammalian animal known is susceptible to rabies with the exception of marine mammals and they too may be susceptible if inoculated with the virus. The disease probably exists in every known country in the world, with the exception of Australia. The explanation for Australia not having rabies is due to the long period of quarantine imposed on imported dogs before they are released.

The period of incubation, for dogs, as given by Professor Moore of Cornell University, may vary from five days to one year, with an average of 21 to 40 days (Ravenal).

The virus of the disease, existing in the saliva, must be inoculated into the tissues, which is most frequently done through wounds inflicted by the teeth of an animal affected with rabies. It may also be produced by a rabid animal licking an open wound. Dogs are the chief source of distribution.

The symptoms may vary greatly in all animals and even in the same kind of animals. There is one symptom that is constant in every kind of animal as well as in the same kind of animal—and that symptom is a progressive paralysis in some particular group of muscles, eventually affecting the entire body. Sometimes it is the group of muscles that close the lower jaw and may be confused, in carnivorous animals, with a bone being lodged in the throat. In such a case the jaw can be easily closed by raising it up with a stick, and when the stick, or support, is removed the jaw drops down again. It is an exception for a carnivorous animal to have a bone lodge in the throat and if by any chance it did there would be severe pain and the animal would be working at its mouth with its foot. Or the paralysis

may involve the hind parts, first noticeable when lying down or getting up.

If bitten by a dog, no matter whether it is believed to have rabies or not, cauterize the wound to its very bottom with a fuming acid like nitric, hydrochloric, or sulphuric. The acid to be preferred is in the order given. This may be done by wrapping a little cotton around a toothpick, dipping it in the acid and cauterizing thoroughly to the very bottom of the wound. This precaution will lessen very greatly the danger of rabies and tetanus (lockjaw), both very dangerous diseases.

Then begin, on the same day, if possible, taking Pasteur's antirabies treatment. This treatment can be obtained in Manila and in many provincial hospitals and, possibly, from some provincial physicians. The treatments should be administered once daily for a period of from 21 to 25 days. If properly administered they are painless and cause no discomfort whatever.

A dog with rabies will usually die about the fourth day after the first clinical symptoms are noticeable—to a close observer. If the dog is in the incubative stage of rabies it is dangerous from 10 to 12 days before the clinical symptoms are apparent, and for this reason it is safest to begin treatments immediately after being bitten by any carnivorous animal and particularly dogs. This precaution may save a life.

If the dog is alive after the twelfth day after inflicting the bite and shows no symptoms of rabies the Pasteur's antirabies treatments may be safely discontinued—and have no further fear of developing the most horrible disease known.

Dogs not only distribute rabies but a number of other diseases, either directly or indirectly, and in view of the fact that so many of them are neither useful nor ornamental the remedy of extermination would seem to be the logical solution, and subjecting all dogs that are not killed to an annual antirabies vaccination.

Many attempts have been made to devise a muzzle for dogs but none have ever been satisfactory, for the reason that it is a physiological impossibility. Some countries have very strict laws prohibiting dogs from running loose, thereby making it necessary to keep them on a leash continually.

COMMUNICABLE DISEASES AFFECTING HORSES

SURRA (*Trypanosomiasis evansi*)

Is believed to have been introduced into the Philippines in racing horses imported from India about 1901–1902.

In the early stages the disease can not be recognized by any clinical symptoms. If a microscopical examination of a drop of live blood be made the organisms can readily be seen and a positive diagnosis be made.

The organisms are conveyed from a surra-infected animal to a well one through the medium of biting flies (*Tabani striati*).

Every horse or mule affected with surra dies. There are no exceptions to this statement. There is no cure for the disease, and many of them have been tried. There is a standing Executive Order that all Government-owned horses affected with the disease shall be killed. Within two or three hours after the death of the animal there is no danger of the disease from the carcass, as the organisms causing the disease have also perished.

After the live organisms causing the disease are injected into the blood of a well animal either by flies or experimentally with a hypodermic syringe, they may be found in the peripheral blood stream in from 6 to 14 days.

The disease is quite chronic in the larger animals. A horse may live several months with it. Carabaos and cattle are susceptible to the disease and a few die of it. Under favorable conditions they will recover, without any treatment, within three to four months. The mortality in dogs affected with the disease is quite high. Man is immune.

The best way known to deal with the disease in horses is to keep them away from infected carabaos and cattle, and sufficiently far apart from each other that flies will not be attracted from one animal to another; and to make a daily microscopic examination of the blood for 15 days at least, after the last case was found positive, and kill all of those found infected immediately.

In carabaos, frequently carriers of surra, it can be detected before the live organisms can be found in the blood, by the complement-fixation test, a big advantage to sugar planters who use saddle horses on their plantations where there are many carabaos.

GLANDERS

Is caused by *Bacillus mallei,* and is fatal in all cases. No cure is known for the disease. In horses it occurs in two forms, i. e., acute and chronic. The acute form resembles pneumonia as the lungs are involved. The chronic form is the most common, and is characterized clinically by a nasal discharge and ulcerations in the nostrils or on the nasal septum. The skin may

also be involved (farcy), characterized by hard nodules which sooner or later break down and ulcerate. In this respect it may resemble epizoötic lymphangitis (*botones*). Sometimes the two diseases coexist in the same animal.

Not all horses affected with a chronic nasal discharge have glanders, but all of them should be regarded with suspicion until they are found negative by a careful mallein test either subcutaneous, opthalmic, or intradermal made by a qualified veterinarian.

If the animal reacts to the mallein test it should be destroyed at once and the carcass burned or buried deeply after having been covered with quick-lime, if available.

The stable, harness and bridle, watering troughs, buckets, and everything that may have become contaminated with the discharge from the nostrils of the animal should be thoroughly disinfected with a five per cent creolin or lysol solution.

Articles having little value, like bedding, refused feed, rags, etc., should be burned.

All other horses that are in the stable, or that may have come in contact with the infected animal, or run in the same pasture, should be subjected to a very careful mallein test, preferably, once every six months and those reacting to the test promptly destroyed and all precautions taken as to disinfection, etc.

Glanders is very dangerous to man, and for this reason it is not advisable to keep a horse with a suspicious nasal discharge.

Carabaos, cattle, sheep, and goats are immune to glanders.

ANTHRAX

Horses are susceptible to anthrax, as are many other domestic animals, but do not come down with the disease as frequently as carabaos, cattle, and sheep. There is one breed of sheep in Algiers that are said to be immune to anthrax for some unknown reason.

Man is very susceptible to anthrax and the disease is very dangerous to him. The most frequent form is a carbuncle on the back of the neck, although it may appear in several forms, but the organism that causes it is always the same.

HEMORRHAGIC SEPTICEMIA

Horses are susceptible to this disease, but carabaos and cattle and sheep are more so. The disease will be more fully discussed under "Communicable Diseases of Cattle." Man appears to be immune to hemorrhagic septicemia.

INFLUENZA

Is a disease having many synonyms. It is known as strangles, pink-eye, shipping fever, stockyards fever, epizoötic catarrhal fever—all of them at one time were known as distemper. In man an analogous disease is sometimes called "flu" which is a contraction of the term influenza.

The disease is characterized by a catarrhal inflammation of the upper respiratory passages.

Influenza frequently appears in horses as an epizoötic, sometimes widespread. Nearly every horse or mule that goes through the big horse markets becomes infected in a mild or possibly severe form, as well as those that are transported any considerable distance on ships.

The symptoms vary in proportion to the severity and complications of the disease. In a mild uncomplicated case there is usually a slight elevation of temperature, with some loss of appetite, more or less coughing, and in a few days a slight serous, later changing to sero-mucous, and finally to a mucopurulent discharge from the nose, which may in a few days diminish and the health of the animal soon returns to normal. Or it may have these more or less mild symptoms with abscess formation in the superficial lymph glands of the head, which rupture in course of time and discharge their contents, even if not opened before, complete recovery following. Or a chronic "roarer" may be the result, which is always a sequela of influenza.

Not all cases, however, progress so favorably. The symptoms may be intensified and complicated with metastatic pneumonia, or an enteritis, characterized by more or less abdominal pain and diarrhea, or a complication of the two affections, terminating in death in all cases. Or a pyemia may result characterized by a slight fever, gradual loss of physical condition, and the formation of one or more internal abscesses in the lymph glands, resulting eventually in death.

A bacterin has been used with varying success as a prophylactic in horses and mules that are sold in stockyards or that are to be shipped overseas. A curative bacterin has not been very successful in the treatment of the disease.

Medicinal treatment of influenza is more or less symptomatic and not successful in all cases.

In the treatment of a mild uncomplicated case of influenza good care and nursing will go far in hastening recovery and lessening the possibilities of dangerous complications.

The animal should be confined in a clean, well-ventilated place and protected from the sun and the rain.

Most cases will be greatly benefited if they are fed and watered on the ground in order to favor, by gravity, the nasal discharges.

Sometimes there is much swelling in the throat that greatly interferes with respiration, and may threaten or actually cause suffocation.

In such a case a tracheotomy should be done at once. The operation is very simple, almost bloodless, and devoid of danger. It consists of making a cut about two to three inches long, including about two tracheal rings, in the upper half of the neck where the windpipe is the most superficial, for the animal to breathe through. The windpipe may be held open by inserting a trachea tube, or a strong suture put in one side of the cut including the windpipe and the suture passed over the neck and into the opposite cut, and then drawn sufficiently taut to hold the wound open. Possibly in four or five days the suture can be dispensed with, and if removed the wound soon closes of its own accord if kept reasonably clean in the meantime.

Influenza is more or less self-limited but with good hygiene and care the chances of an early recovery are greatly improved.

EPIZOÖTIC LYMPHANGITIS (*Botones*)

Is characterized by the formation of small, superficial, acutely painful abscesses along the lymphatic vessels.

It is believed that it is conveyed from one animal to another mechanically through the use of contaminated harness, brushes, etc. But there is some doubt as to just how it is disseminated.

It is caused by a fungus (*Saccharomyces farciminosus*) and may coexist with glanders of the skin (farcy), which in itself is incurable.

If uncomplicated, epizoötic lymphangitis is generally curable but the successful treatment is slow and tedious in most cases.

If treatment is attempted it would be advisable to dissect out the small nodules as soon as they can be detected, under aseptic precautions, before the formation of abscesses and close the wound with a suture or two or else treat it as an open one by keeping it clean.

Or after the abscesses have formed they may be opened under aseptic conditions and the inside of the abscess cavity scraped (curetted) and then cauterized with a red hot iron, or a small piece of cotton may be wrapped around a short piece of wire and dipped in terchlorid of antimony solution, or pure carbolic

acid, and the inside of the abscess thoroughly swabbed with the drug used. Or powdered sulphate of copper or silver nitrate on a small pledget of cotton may be inserted into the cavity.

By dissecting out the small nodules, or opening up the abscesses as soon as formed, and treating as above, a cure will, in course of time, usually result.

Major Kelser, Veterinary Corps, U. S. A., has had very encouraging results by the intravenous injections of a mercury solution, but the method is technical and the injecting would necessarily have to be done by a qualified veterinarian.

Medicines administered by the mouth have little or no value in treating epizoötic lymphangitis.

NON-COMMUNICABLE DISEASES OF HORSES

OSTEO-POROSIS (BIG HEAD)

There are a few people who regard the disease as communicable, but their theory is not very convincing.

At present the disease is generally regarded as a nutritional disease, characterized by a calcareous degeneration of the bones, which become greatly increased in size and decreased in weight. The bones of the face and lower jaw are greatly enlarged, in an advanced case of the disease, and honeycombed. However, every bone in the body is more or less involved, becoming fragile and very easily broken. For this reason it is dangerous to throw and tie a horse with osteo-porosis even in the early stage of the disease.

A migratory lameness may be one of the first symptoms noticeable. If the bones of the face and lower jaw are examined at this time they will be found to be enlarged. As the disease progresses the lameness becomes more pronounced, and the bones of the face and lower jaw become larger and larger. The teeth become so tender and sore that the animal will eat with difficulty and all symptoms now become exaggerated, until finally the animal goes down, is unable to rise, and eventually dies in decubitus.

The disease is known in many different countries and generally appears in limited areas where the feed is deficient in lime and phosphoric acid.

The treatment of the disease may be attempted in the early stages by giving a complete change of feed and environment. In the later stages this is not advisable.

In addition to giving feeds that are rich in minerals these may also be supplemented by giving slacked lime or lime phosphate in the feed once or twice daily. However, they are not

assimilated by the animal as readily in this form as when they exist naturally in the feed itself. It is possible that raw bone meal given in the feed would be of some value, as it is in similar affections in cattle and hogs.

Probably the tendency of the disease in certain localities could be overcome by fertilizing the soil with lime and phosphates in order to produce a quality of feed that is richer in minerals. A similar disease, osteomalacia, has never been reported in carabaos or cattle in the Philippines.

TETANUS (LOCKJAW)

The disease is very prevalent among horses and carabaos in the Islands, and the mortality is very high for the latter, and about fifty per cent for the former.

All mammals, including man, are susceptible to tetanus. The organism (*Bacilli tetani*) that causes the disease is widely distributed in nature and is invariably introduced through a wound, and for this reason all wounds are dangerous.

The period of incubation for horses and carabaos ordinarily will average about three weeks, and the duration of the disease in all animals that recover will vary from five to nine weeks.

An injection of 1,000 to 2,000 antitoxin units of antitetanic serum within a few days after receiving the wound is almost a certain preventive. It has little, if any, merits as a curative after the disease has once developed. If given at all as a curative it should be given in doses of 50 to 60 times as much as when given as a preventive.

It would be advisable to give the serum to horses and carabaos as a regular routine measure in case of wounds, particularly punctured wounds of the feet, and after castration it should be given in all cases.

Tetanus is not communicable from a sick to a well animal. If the disease is once seen in a horse or carabao it is not easily mistaken for any other affection. The animal is more or less "stiff" when standing or moving, depending upon the severity of the disease. The nose is more or less extended, the nostrils look pinched, the ears in the horse are held more or less upright, the tail is sligthly elevated, and the hind legs spraddled when standing or walking. The membranes nictitans are more or less contracted, and if the head is raised and the nose slightly extended by lifting the lower jaw, they will contract and cover a considerable portion of each eye, which makes it appear that the eyes are drawn back into their sockets.

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The treatment for a horse is to put it in a dark and quiet place to lessen annoyance from flies. Place the feed and water on a level with its head and keep away from the animal as much as possible and give Nature, the resisting forces within its own body, a chance.

Medicines have, at best, only a temporary value, if any. If they are given at all they should be given in the feed. Under no circumstances attempt to drench the animal as it would certainly do more harm than good. The ponies that we occasionally see in the streets of Manila and elsewhere in the Islands, that have been "fired" on both sides of the neck as a curative for tetanus recovered in spite of the treatment and not because of it. The hundreds that have been killed as a result of this treatment we do not see.

The nervous system is involved and the animal is very nervous and irritable and for this reason absolute quiet is most necessary to aid in recovery.

If the case is a rather severe one the horse will not, ordinarily, lie down, and if it does the chances are that it will never get up again, but will struggle for possibly three or four hours and then die. Under such circumstances it would be much better to destroy the animal at once and prevent unnecessary suffering. However, as long as the animal can stand on its feet there is a chance for it to recover, but if it goes down and is unable to rise there is none.

LAMINITIS (FOUNDER)

Is a very common affection in all breeds of horses and particularly Philippine ponies. It consists of first a congestion, followed by an active inflammation, if not prevented, of the sensitive lamina or fleshy portion of the foot most frequently in the fore, very rarely in the hind, feet. When it does occur in the latter but one foot is affected; and this is invariably due to a very acute lameness in the opposite hind foot which prevents the animal from supporting any weight on it. In course of time the foot supporting all the weight may become strained resulting in a congestion and followed by an active inflammation.

Laminitis is the result of numerous and varied causes. It may result when an animal stands in one position for any length of time, as on ships, or tied up in the stable so it cannot lie down, resulting in strains. It frequently follows intestinal disturbances as a result of a gorge in feeds, excessive purgation, and sometimes parturition. The most frequent cause is concus-

sion on hard roads (road founder). In all of the above cases both fore feet are invariably affected. If only one foot is affected it is invariably the result of the opposite foot being so acutely lame that the animal will not stand on it.

The symptoms, at first, may be somewhat confusing but later unmistakable. At first the animal will, as a rule, persist in standing, in a very stiff attitude, with the nostrils pinched and the face having an extreme "anxious" expression, indicative of the intense pain that it is suffering. There may be acute stab-like pains that will nearly throw the animal off its feet. It has a strong disinclination to move, and if it does the fore feet are thrust far forward and the weight is supported as much as possible on the heels. The hind feet are placed well up under the body in order to take as much weight off the fore feet as possible. This gives the animal a peculiar cat-like movement sometimes called pussy-footed.

As soon as the animal lies down and thereby takes the weight off the feet it experiences much relief, and will then persist in lying down much of the time, and if the ground is not soft, or the floor of the stable is not well bedded, it will soon develop bedsores.

If the animal is treated vigorously, and properly, within 24 hours after the attack the greater will be the chances of a complete recovery and the earlier the treatment the greater are the possibilities of favorable results.

In the treatment of a case of acute laminitis, not the result of superpurgation, an active purgative is indicated. For a pony you may give 300 to 500 c. c. of raw linseed oil or about nine grams of powdered aloin either in a capsule or in a solution. Within 18 to 24 hours purgation should result. In the meantime give the animal all the water that it will drink and very little, if any, feed. After the purgative has become active give very little, or no, water to drink. If purgation does not cease within 36 hours give flour or rice-water gruel only to drink.

In the meantime stand the animal in water well up over the hoofs, for at least three to four hours at a time, and then take it out of the water and let it lie down on a soft bed and rest the feet for several hours at a time. Wrap the affected feet with heavy cloths during this time and keep them well saturated with water. Repeat the process for a week or two.

If it does not respond to treatment by this time the probabilities are that chronic laminitis will result. If it does there is a separation of the sensitive lamina from the insensitive at the toe

which becomes greatly thickened and more or less deformity takes place and the animal thereafter is fit only, more or less, for breeding purposes.

FLY-BLOW

This is the most troublesome every-day pest that the livestockman has to deal with. Cattle frequently receive wounds when running loose in the bushes and unless the wound is some place where the animal can get at it with its mouth to keep it clean, it frequently becomes fly-blown and death may result. All animals that are castrated and new-born calves should be watched closely. It lessens the danger very greatly if an animal that has been castrated has the wound treated with an application of pine tar once daily and the navel of a recently born calf receives a similar treatment until it becomes dry.

The eggs of the fly are deposited in the wound by a large blue-colored fly (*Musca vomitorium*) and there soon hatch into maggots, the larval form of the fly, which are very resistant to any of the ordinarily used chemicals. They will live for some time in a strong carbolic acid solution, for example, and are very difficult to destroy in a wound unless chloroform is used.

There are many different kinds of fly-repellants that may be used, all of them having some value, and none of them having very lasting value. All of them must be frequently applied until the wound has healed.

Deep-punctured wounds that the animal cannot take care of are the most dangerous. It is best to scrape them out thoroughly with a blunt curette, including all the necrotic tissue, and then saturate a plug of cotton with camphorated oil, made by using one part of spirits of camphor to two parts of a heavy vegetable oil, preferably raw linseed oil, or as a substitute coconut oil, and plug the wound to the bottom with the medicated cotton just sufficiently tight to keep it from falling out. A little oil of pine tar may be added to the camphorated oil if available. The maggots that may be left in the wound or that are subsequently hatched from the eggs that are left in the wound will work their way out and fall to the ground rather than stay in the wound in which there is an oil and a volatile substance like camphor.

Pine tar may be used as a substitute for the camphorated oil around the edge of the wound as well as inserted on a plug of cotton into the wound and to its very bottom. Or you may use one part of lysol to six or seven parts of kerosene in the same way. Commercial chloroform is also very destructive to maggots

and will kill them in the wound; but, if the wound is deep or otherwise not favored by drainage, the dead maggots should be curetted out within 10 or 15 minutes to prevent them from putrefying in the wound.

It greatly facilitates the handling of wounded animals if a "squeeze" or stocks is built inside of the corral for the purpose of restraining them for the daily treatment of the wound.

Every animal that dies on the range should be promptly burned or buried deep, as well as all animal matter that may decay, in order to lessen the breeding places of the blue-bottle flies that lay the eggs which hatch into maggots.

HEAT PROSTRATION (HYPERPYREXIA)

This is a frequent occurrence with horses and mules in Manila and no doubt occurs in the provinces with native ponies more frequently than is generally suspected.

It most frequently occurs with horses that are being worked and particularly so when the weather is very hot following a rain. The humidity is very great at this time, which greatly interferes with the normal dissipation of heat from the animal's body through the skin.

It is said, and with more truth than poetry, that a competent driver never lets a horse that he is driving go down with the heat—and the frequent falling of horses, with possible broken-knees, may also be attributed, very largely, to incompetent driving.

It is an exception for a horse that is "hog-fat" to go down with heat prostration. The digestive organs of horses that are fat are functioning perfectly on the food that they receive; otherwise they would not be so fat and in such good physical condition.

The affection invariably occurs in a horse that is out of condition as indicated by poor physical appearance, lack of gloss in hair, etc. A flighty, rattle-brained, free-going animal is particularly liable to go down in the street, if the driver is not reasonably careful and on his guard. The animal will always give due warning if the driver can interpret the signals. They consist of staggering from side to side, lugging on the lines, possibly walking into objects, dilated pupils, lack of perspiration, etc. The animal may appear to be out of its head due to the intense congestion in the brain, and more or less uncontrollable before it finally goes down. If the temperature is taken at this time the mercury in the thermometer may be up near the end, and might go higher if the thermometer was longer.

When down the animal will thrash about violently and knock its head on the hard pavement, in its delirium.

The treatment consists in having an assistant hold the head still and prevent the animal from injuring it on the hard ground or pavement. Then, if ice is available, fill a gunnysack about half full of cracked ice, and place it under the head and another one filled the same way on top of the head, and another one filled the same way over the heart. If possible, provide shade for the animal, and then shower it with water from a hose, if one is available, or carry water and dash it on the animal's body, in order to lower the temperature as soon as possible, as an animal with such a high temperature cannot live very long. Three to four hours of vigorous work may save the animal, if the efforts are properly applied. The heavier the animal the more unfavorable the prognosis. The showering should be kept up until the temperature is normal, and then the animal watched closely for 10 to 12 hours afterwards as the temperature may go up again and if it is not promptly lowered the prognosis is decidedly unfavorable.

People that have been overheated are advised to keep near the "snow line" ever afterwards. Horses that have been overheated in a tropical climate are practically ruined thereafter for service. In cold climates they will do fairly well until warm weather sets in, when they should be turned out to pasture.

Improper feed has much to do with the out of condition state so frequently seen in horses in the Islands, and particularly so in imported horses kept by liverymen in Manila who are trying to subsist their animals on foods that they cannot digest.

PERIODIC OPTHALMIA (MOON BLINDNESS)

The name suggests periodical, or intermittent, blindness. The synonym "moon blindness" is sometimes applied to the affection for the reason that the moon appears periodically also, and not because there is any relation whatsoever between the appearance of the moon and the blindness.

The disease appears quite frequently in native ponies as well as all other types and breeds of horses.

It is seldom if ever noticeable before adult life. It may affect one eye or both eyes simultaneously. It may cause only partial or complete blindness in one eye or both eyes, but generally not until there has been several attacks, or rather acute exacerbations of the primary attack or onset of the disease.

Nothing is known as to the exact cause, but it is believed to be constitutional, and consequently local treatments applied to the eye have little, if any, value.

Treatment is not very satisfactory, and many kinds have been tried. The best treatment is not to have it by not breeding to animals affected with it, as it is certainly hereditary.

There is some very important research work under way, as to the possible cause of the disease, that may be of far-reaching importance. In some countries the disease assumes an epizoötic form and is the the greatest menace that horse breeders have to deal with.

Horses and mules are the only animals known that are affected with periodic opthalmia.

There is an affection that is quite common in carabaos, but less so in horses and cattle, somewhat resembling periodic opthalmia in horses, which is known as *Filaria oculi.* It is caused by a very short, almost white, worm that is visible to the unaided eye that inhabits the anterior chamber of the eyeball.

The treatment consists in puncturing the anterior chamber of the eye in the proper place and letting out the fluid and with it, possibly the worm or worms as the case may be. Or hooking them out, with a specially devised hook after the anterior chamber to the eye has been punctured. However, removal of them may be followed by others which are found in the blood stream.

In either case it would require a qualified veterinarian to do the work, as a knowledge of the anatomy of the eye is essential.

A similar blood parasite (worm) is found very frequently in dogs in the Islands, known as *Filaria immites,* that may pierce the heart muscle in such numbers as to cause the death of the animal.

Intravenous injections of salvarsan (606) have been tried in these cases, but without success.

DIGESTIVE DISTURBANCES

Are more generally known as colics and are of very frequent occurrence in any breed of horses and mules, and particularly so in Philippine ponies for the reason that they are fed with such a large variety of foods.

The less variety of foods fed horses the better, for the reason that their digestive juices do not act readily on a sudden change in feed nor on a great variety of foods fed at the same time.

The word "colic" is a term that is used more or less by the laity to indicate pain in the abdominal cavity, without reference to the exact cause. They may be classified as false and true colics. The former is implied when the pain is secondary to some other affection as laminitis, pneumonias, toxemias, etc. When the pain is due primarily to or originates in the intestinal tract it may be regarded as true colic. It may be due to a number of causes, as engorgement of foods, flatulency caused by gaseous fermentation of foods, obstruction in circulation of blood to the parts as from a twist, or misplacement of the bowel, either partial or complete, also impaction of the cæcum or double colon. Again it may be spasmodic in character resulting from a nervous disturbance to the parts, or verminous from parasites within the intestinal tract or within the blood vessels supplying some portion of the tract.

It would serve no useful purpose, in an article of this kind, to attempt to enter into a detailed discussion of the various classifications, and their causes, of colics.

They are frequently the result of indiscretion in feeding and watering but if proper care is taken the possibilities of the animals getting the disease are greatly lessened.

The onset of true colics is sudden, usually severe, and frequently mortal. In such a case if a careful post-mortem search is made an obstruction or inflammation of the digestive tract, in some form or another, due to many different conditions or causes, will usually be found. The attack may be of short duration or prolonged. The more acute the symptoms the quicker the case will terminate in either death or recovery.

A horse suffering with colic is up and down, rolling and tumbling, in its efforts to find some position that will give it relief from the intense pain.

If death occurs quite suddenly it may be due to a ruptured stomach or a large bowel, or a strangulated intestine, either partial or complete. If the colicky pains are more or less prolonged, lasting for several days possibly, an impaction of the cæcum, or double colon, may be suspected.

The prognosis in all of the above conditions is decidedly unfavorable, and in every case of colic guarded. A twisted or misplaced bowel may, through some unexplained miracle, right itself and the affected parts return to normal. An impaction of the large bowels may, possibly, by administering an enormous quantity of saline solution into the stomach through a stomach

tube, thereby supplying moisture and increasing intestinal peristalsis, break down the impacted mass. However, such a favorable termination would be very exceptional indeed.

Colics that are due to fermentation of foods, causing an abnormal amount of gases to form, are generally known as flatulent colics and those resulting from a disordered nerve supply to the bowel as spasmodic colics.

Many of these colic cases will recover, and that without any kind of treatment. On the other hand, it is believed that many of the cases that might have recovered without any treatment have died as a result of improper treatment.

If a qualified veterinarian is not called to treat an animal suffering with colic, it would have a much better chance of recovering if provided with a soft and deep bed to roll on, to prevent it from injuring itself, and no medicines whatsoever.

It is a mistake to keep an animal moving, or to prevent it from lying down, or to drench it with noxious and too frequently contra-indicated remedies when it is suffering with colic. It is true that occasionally a case will recover under such adverse circumstances, but the recovery is in spite of such practice, and not due to, any beneficial influences derived therefrom.

The prognosis in all of the false colics depends upon the causes that produce them. Some of them are decidedly unfavorable due to the very nature of the malady to which they are but secondary.

Horses are more susceptible to colics when they are fatigued, or when watered after feeding. They very seldom have it when running loose in pastures.

SUPERPURGATION (ACUTE DIARRHEA)

In the entire range of the animal kingdom, including human, there is no animal that is so easily upset as a result of intestinal disturbance as is the horse. Why this is true may in a degree be understood by one having some knowledge of the anatomical and physiological peculiarities of the digestive tract of this animal.

It is not an unusual occurrence when driving or working a horse just off of green grass for it to develop loose bowels after it has become warm. This is a danger signal and shows it is time to stop the horse from exerting himself further.

Superpurgation from the administration of purgatives may occur when the purgative has not been properly selected and

administered, and particularly so if the animal is worked in the meantime besides.

The symptoms are self-evident, i. e., a severe diarrhea and rapid prostration of the animal, which may terminate very quickly in death. The animal will refuse food, but drink an enormous quantity of water if it is accessible, which greatly aggravates the diarrhea and hastens death.

The treatment consists in placing the animal in clean, comfortable quarters, tying it so it can lie down, and keeping it perfectly quiet.

Give it absolutely nothing to eat or drink except flour or rice-water gruel, made fairly thick and with hot water which, after cooling, the animal will drink readily as it is extremely thirsty.

Under no circumstances attempt to lock up the bowels with opiates or any other kind of drug for they will certainly do more harm than good.

The best purgative for horses is aloin, the neutral principle of aloes. It may be given in the powdered form in a capsule. Usually 15 grams is sufficient for a horse weighing 500 kilograms. A one-ounce capsule may be packed lightly or firmly and then administered with the hand or a balling gun. It usually takes a little practice to administer it with the hand successfully. Or you may use from 12 to 15 grams of the powder in a half liter of water and give it in solution with a drenching bottle or with a dose syringe.

As a substitute you may give from 400 c. c. to 500 c. c. of raw linseed oil with a drenching bottle.

Epsom salts is the best purgative for carabaos, cattle, sheep, and goats, but is decidedly uncertain and unreliable as a purgative for horses.

After giving the purgative (physic) let the horse stand quietly (do not work it) and give it all the water it wants to drink until the purgative begins to act, which should be in from 18 to 24 hours.

Ordinarily a purgative will continue to act from 24 to 36 hours after it has once started. During this time keep the animal absolutely quiet and give it only a very little water to drink. If it begins to show much weakness, prostration, etc., give it the flour or rice-water gruel to drink, three to four liters at a time and frequently repeated, and absolutely nothing else.

FORAGE POISONING (BOTULISM)

There have been several outbreaks of the disease in the livery stable horses in Manila during the last few years, and the mortality has been very high in the animals affected.

In all the cases the animals had been fed with paddy (barit) grass, which is the usual feed for livery stable ponies in Manila. The grass is invariably cut from two hours to several days before it is fed and, consequently, may be undergoing more or less fermentation which is greatly favored by the grass being cut when it is very green, and tied up into well-packed bundles while it is warm and full of moisture.

These conditions are favorable for the growth and multiplication of the specific organisms (*Bacillus botulinus*). The organisms start their growth in colonies where the conditions are favorable, and eliminate a toxin (poison) from their bodies which is devoid of odor and can not be seen with the unaided eye. The toxins permeate the surrounding nest, or colony, of the organisms, and when an animal eats the feed it may get a sufficient amount of the poison to produce the most violent toxic symptoms, followed by death, according to Seddon. Very rarely will an animal recover. It depends upon the amount of poison that it has received. The symptoms may not appear until several days after eating the contaminated feed.

The symptoms vary in proportion to the amount of toxins that is ingested. The animal may die within a few hours or days, or possibly recover.

There is usually some abdominal pain and if the animal lives long enough there is usually a profuse diarrhea, loss of appetite, and an intense thirst. If the animal has ingested a sufficient amount of the poison death may take place within a few hours after the first symptoms are noticed. The visible mucous membranes in the mouth will vary in color from bluish to bluish-black; and there will be a very offensive odor, profound prostration, extremely rapid and wiry pulse, dilated pupils, anxious facial expression, slightly tympanitic, muscular tremors (a bad omen in any disease), soon followed by death.

The treatment is to keep the animal absolutely quiet, and give it nothing to drink except flour or rice-water gruel. There is no medical treatment known that has any beneficial influence on the disease whatever.

In man an analogous condition, caused by the same organism, is known as ptomain poisoning. In poultry, particularly

chickens, there is motor paralysis causing the neck to become so limber that they cannot hold their heads up, and for this reason the disease, caused by the same organism, is known as "limber neck." It is usually caused in chickens from eating decayed meat, also from eating maggots or fly larvae. Death usually takes place in chickens affected with limber neck.

The organisms (*Bacillus botulinus*) that produce the disease will develop on dead material only, which may be either animal or vegetable, and by taking advantage of this fact and feeding only fresh feed—that in which putrefaction has not started—there is little, if any, danger of the disease. However, in feeding fresh grass there may be much dead material around the lower part, or butts, that should be removed from the green grass when it is cut and before it is fed.

MYCOTIC GASTRO-ENTERITIS

Is a more or less acute inflammation of the mucous membrane of the stomach and intestines produced by a mold fungus that is frequently seen growing on decomposing or damaged feeds.

The symptoms are very similar to those of botulism but differing in post-mortem findings, in that there is a very noticeable inflammation of the gastro-intestinal tract.

The treatment of the disease is decidedly unsatisfactory under any and all circumstances. But the palliative treatment suggested for botulism would be applicable.

The disease may coexist with botulism. The best treatment is that of prevention and this lies in not feeding moldy or otherwise damaged feeds.

LAMENESS

The detection of the exact location of lameness will ever be more or less baffling even to a person with some anatomical and physiological knowledge of the parts concerned in addition to keen observational acumen and much practical experience.

Generally speaking, the more acute the lameness the easier it is to locate. In the fore limbs fully 95 per cent of all lameness is below the knee, and about 75 per cent of this lameness is in or below the fetlock joint.

In the hind limbs fully 85 per cent of all lameness is either in or below the hock-joint.

There is an old saying that has been handed down for generations: "It is a good policy to search the foot for a nail puncture even though the leg be broken." The old adage is, of course,

exaggerated, but it is used for the purpose of emphasizing the importance of searching the foot very carefully in all cases of lameness. A horse with a broken leg should be destroyed, at the earliest possible moment, to terminate unnecessary suffering. For no one has been justified, by results, in treating a horse with a broken leg.

In fairly acute lameness above the knee, or the hock, the animal will not extend the leg easily and fully and the limp is very apparent, to the practiced eye, when attempting it. This form of limp is known as swinging leg lameness and takes place when the leg is being advanced.

If acutely lame in the foot the animal will extend the leg normally, but hesitates to put the foot to the ground and support its weight on it, and when it does there is a marked limp, as a result of the weight, known as supporting leg lameness.

A horse's foot may be briefly described as consisting of three feet, each one enclosed, or nested, and an exact counterpart of the other. The inner foot consists of the column of bones at the terminal end of the leg; the middle is the fleshy, vascular, or membranous foot, while the outer covering of the foot is the horn.

There is a saying as old as Xenophon: "No foot" ("legs" should be included), "no horse." This old saying is just as true today as it ever was and always will be. To paraphrase: "No heart, no arteries: no man." There is no chance of anyone ever changing their import.

In examining a horse for soundness the feet and legs are first to be considered. Other possible defects are, as a rule, of secondary importance. When a physician examines a person for soundness the heart and arteries are usually first considered.

No specific treatment, except rest, can be arbitrarily laid down for the treatment of lameness. One must seek the cause and direct the treatment accordingly.

In fore-limb lameness the foot should be searched carefully for nail-puncture or one or more nail-pricks, if recently shod; a possible abscess in the foot from a bruise, or a possible soft sole and particularly so if the weather is rainy and the sole of the foot has been pared during shoeing. Failing to find anything wrong with the foot the flexor tendons between the knee and fetlock should be palpated for a possible tendinitis or a bowed tendon, or the back part of the fetlock itself may be the seat of the lameness. Splint lameness is usually self-evident, and the lameness may be noticeable only when trotting.

If the animal persistently points with one fore foot when at rest navicular disease may be suspected. If it alternately points with first one fore foot and then the other one, navicular disease in both feet may be suspected. In such a case the animal when moving is considerably shortened in its stride and stilty, as the saying goes, with a strong inclination to stumble when traveling.

Navicular disease constitutes an unsoundness as it is incurable and has a tendency to increase in severity, no matter what the treatment may be.

The lameness may be relieved, for a time, in many cases by taking out a section of the nerve on both sides of the leg, if below the knee, or the median nerve at the elbow, but it will not cure the necrosis going on in the navicular joint which is inside of the hoof. On the other hand, the neurectomy may hasten a complete breakdown at the joint from a ruptured flexor tendon that supports the navicular bone at the joint, or a gelatinous degeneration taking place in the foot.

If there is lameness in a hind leg and if nothing is wrong with the foot, the possibilities are very great that the lameness is due to a bone spavin, which may or may not be apparent to the eye.

A mercurial blister properly made and applied will frequently relieve the lameness from a bone spavin, for an indefinite time, but it will not remove the bony growth should there be one. A bone spavin is, in itself, incurable and constitutes an unsoundness.

Navicular disease seldom occurs in a hind foot, and when it does it is generally the result of a deep nail-puncture that has penetrated and injured the joint.

No case of lameness is benefited by exercise. In addition to appropriate treatment for the specific cause of the lameness, the animal should have complete rest. It should be supplied with deep bedding, if kept in a stable, and be permitted to lie down, which will not only be good for the particular kind of lameness for which the animal is being treated, but will lessen the possibilities of laminitis in the other foot as a complication.

SOME PECULIARITIES OF THE HORSE

1. It has more non-communicable affections than communicable ones, due to the daily hazards that it is subjected to as a result of domestication and artificial environments.

2. Its action speaks louder than words if we could only understand the mute language, and they never tell a lie.

3. A horse can not breathe through its mouth nor can it vomit, even if it becomes very seasick, or if given emetics, for the reason that it has no vomiting center in its brain.

4. It will seldom, if ever, give up and lie down to die as long as it can possibly stand on its feet.

IN CONCLUSION

Breed it right, feed it right, and use it right, and it will help pay off that I. O. U.

It has been said that the dog is man's most faithful friend, and that the horse is the noblest animal God ever made without a soul. It has done as much, if not more, for the prosperity and civilization of mankind than any other animal.

One of the foremost European statesmen, of his day, once remarked that there never could be a revolution in England for the reason that with a people who love horses all men are equal on the turf and under the turf—which is democracy to the core.

COMMUNICABLE DISEASES OF CARABAOS

As carabaos are susceptible to about the same kind of diseases as cattle, their maladies will be included with those of cattle. There are, however, certain exceptions to this statement, viz., carabaos are not susceptible to (1) Texas fever, (2) *Anaplasma marginale,* and, possibly, (3) tuberculosis.

COMMUNICABLE DISEASES OF CATTLE

RINDERPEST

Is an exceedingly communicable and destructive disease to which all cloven-hoof animals, as carabaos, cattle, deer, hogs, goats, and sheep, are susceptible.

The disease has existed in Central Asia since time immemorial and has spread over the greater part of Asia, to South Africa, and even to Europe from time to time.

It is believed to have been introduced into the Philippines from Asia, about 1882, where it has existed ever since, either sporadically, enzoötically, or epizoötically. It has now spread to many islands in the Archipelago wherever the interisland movement of susceptible animals is more or less unrestricted.

The very first symptom of the disease is a rise in temperature, which can best be detected by the aid of a clinical thermometer that may be in either the Fahrenheit or Centigrade scale, of from two to six degrees in the former, and from one to four

degrees in the latter. The temperature varies according to the severity of the disease. Even at this stage of the disease it is communicable. The high temperature is followed by almost, if not complete, loss of appetite, and the animal will stand apart from the others. There may be constipation at first, followed by more or less loose stools, and then by a more or less severe diarrhea which may or may not be mixed with blood. By this time the nose has become very dry and all the visible mucous membranes including the conjunctiva of the eyes extremely red, and they soon begin to discharge a serous, followed by a sero-mucus, and lastly by a muco-purulent secretion. If a careful search is made at this time along the margin of the gums and where the cutaneous surface joins the mucous membranes on the lips and anus small papules may be detected which eventually break down and form ulcers covered with a yellowish-grey exudate. As a result of soreness there is more or less drooling of a sticky saliva that may hang from the mouth. The animal lies down much of the time, with the head drawn round toward its flanks, frequently grinds its teeth, and shivers as if it was having a chill. On careful observation tremors of certain groups of muscles may sometimes be seen, which is a bad omen in any disease. Death seldom takes place before the third day of sickness. If the animal recovers it does so very slowly, and the hair loses it natural gloss and looks "weather-beaten." The mortality may vary greatly in different outbreaks; in some it may be as low as 60, in others as high as 90 per cent. If the animal recovers from rinderpest it is generally immune for the rest of its life. The incubation period may vary from 3 to 16 days.

The morbid appearance of an animal that has died of rinderpest is very pronounced in the small intestines, especially at the junction with the large bowel. They may vary from a red to a reddish-black in color, and the mucous membrane will readily separate from the underlying tissues.

All of the discharges from the bowels, mouth, nose, eyes, and the bladder of an animal that is infected with rinderpest contain the virus of the disease and are dangerous to other susceptible animals if they are taken into the mouth with the food or water. The virus in the discharges may be carried on the feet of any animal, and on the wheels of vehicles, or in many other ways, and contaminate the food or water that may be taken by a susceptible animal and thereby infect it.

The procedure in a case of rinderpest is the same as that for any other dangerous communicable disease, and has been given in detail in the beginning of this section. It consists largely in tying the animal or animals up, or otherwise restraining their movements, as near the place in which they are found as possible, and then notifying the proper officials at the earliest possible moment. This precaution may not only save money for yourself, but for your neighbor, and for your Government. Then have your animals vaccinated with rinderpest vaccine, and use your influence with your neighbors so that they too will readily submit their animals for vaccination when the opportunity presents itself. This is the very best method known in dealing with rinderpest, which is a proved fact and not a fanciful theory.

About every drug in the pharmacopeia, and various combinations of them, have been tried out and all of them found to be absolutely worthless in treating rinderpest. Again, imagine, if you can, just how it would be humanly possible to attempt to medicate, for instance, a breeding herd of possibly 500 or 600 head of semi-wild, or unhandled, cattle if you were going to give many of them medicine every three or four hours, and possibly a number of herds, widely separated, infected at the same time?

FOOT-AND-MOUTH DISEASE (VESICULAR APHTHA)

Is one of the very oldest cattle diseases described, and little more is known of it today than when it was first noticed, notwithstanding the fact that some of the most brilliant minds of two continents have worked on it for many years. It is believed to be the most communicable disease of domestic animals. All cloven-hoof animals are susceptible to it as to rinderpest. It is said that man is susceptible, but authentic cases are decidedly uncommon. The cause of the disease is unknown but the virus exists in the saliva and in the vesicles that form on the coronary band of the feet and between the hoofs on the soft parts.

The disease is prevalent in the Islands and appears from time to time as either a sporadic case, an enzoötic, or as an epizoötic. The mortality from the disease in the Philippines during the year 1927 was less than 1 per cent for carabaos and less than 2 per cent for cattle. It will probably not exceed 5 per cent in any country.

The first symptoms are usually a slight loss of appetite, and a slight rise in temperature. The nose becomes dry and the mouth quite hot and tender. Within a few days a frothy saliva having a distinctive odor may hang from the mouth. If the inside of the mouth is examined at this time small ulcers may be seen on the inside of the lips and cheeks and on the sides and upper surface of the end of the tongue that may vary considerably in size. As a result of the sore mouth the animal will frequently make a peculiar smacking sound. About this time the feet become more or less tender and vesicles appear on the soft parts between the hoofs and on the coronary band. They soon rupture leaving an ulcer. Several of them may join together and produce quite a large ulcer, because of which the animal shows marked lameness, and persists in lying down much of the time to get more comfort, as a result of taking the weight off the feet.

The treatment is purely symptomatic and once in a herd, the sooner it affects all of the susceptible ones the sooner it will be over with. Many people will, and wisely too, deliberately try to infect all their animals in order to have it over with, for it is practically impossible to limit its spread by quarantine methods after it has appeared on a farm or in a herd. This method is particularly advisable if the disease appears on a hacienda and out of the busy season.

It expedites the healing process in the mouth very much if the mouth is washed out with salt water three or four times daily. The ulcers on the feet should be washed several times daily with a 2 per cent creolin solution and then daubed over with pine tar to keep the flies away. The animal should be provided with dry quarters and deep bedding to lie on. Sometimes the hoofs are shed and then the animal had better be killed and buried. Again, a laminitis may develop and a deformed hoof result. In such a case it would be better to send the animal to the butcher after it has fully recovered from the primary disease. Frequently rings will form around the hoof and grow down with it. In such a case it would take about one year to grow a new hoof and thereby obliterate the marks left by the disease.

ANTHRAX

Is one of the oldest communicable diseases known. The organism (*Bacillus anthracis*) that produces the disease is one of the very first microörganisms discovered. The disease exists in every known country in the world and there is little, if any,

possibility of ever changing this state of affairs for reasons that are forthcoming.

Anthrax may remain more or less quiescent, like an inactive volcano, for a number of years with possibly a single case developing here and there that may or may not be recognized. Then when conditions are just right the disease may break out into a more or less extensive epizoötic as it did in Central Luzon in the year 1923. So far as known anthrax was first reported in domestic animals in the Philippines in 1904. This does not necessarily mean that it had not existed in the Islands for many years before, but possibly it had appeared only in sporadic cases and therefore was unrecognized. Anthrax had been reported in people in the Islands long before this time, and as the organism that causes the disease in people is the same as those that cause the disease in the lower forms of animal life, and vice versa, there is every reason to believe that the disease has existed in the Islands since time immemorial.

All herbivorous animals, particularly the ruminating ones, as carabaos, cattle, sheep, goats, and deer, are highly susceptible to the disease, with the exception, previously mentioned, of one breed of sheep in Algiers that are said to be immune, for reasons that are unknown.

The period of incubation of anthrax is very short. When experimentally produced it may vary from one to five days.—MOORE.

The most common channel of infection is through the mouth with contaminated food or water. However, the organisms that cause the disease may find entrance to the body through wounds in the skin or through the respiratory tract as a result of inhaling dust, etc.

In man the most common form of the disease is a carbuncle on the back of the neck. The organisms may also find entrance through the digestive or respiratory tract. Shaving brushes made from the hair of animals that have died of anthrax, or were otherwise contaminated, may convey the disease through a wound on the face when shaving.

The clinical symptoms of anthrax vary greatly not only in different animals but in the same kind of animals.

Anthrax occurs in three forms known as peracute or apoplectic, acute, and subacute. It is also classified as anthrax with or without visible local lesions.

In the peracute or apoplectic form, as the name indicates, the animal dies very suddenly with possibly symptoms, if any

are noticeable, of a brain disorder. Carabaos, cattle, and sheep are the animals most frequently affected with this form of the disease.

In the acute form the animal generally dies within 24 hours. In such a case the temperature is high—possibly 40° to 42° C., or 104° to 108° F. With such a high temperature from any disease, there may be delirium or other forms of brain disturbance due to the extreme congestion of the brain with blood and the resulting toxins from the organisms that may be causing the disturbance. In the peracute and acute forms there are seldom, if ever, local signs as swellings or tumefactions.

In the subacute form the disease is much slower in its course, as in this form the organisms have generally gained entrance to the body through wounds in the skin. In this form the disease may last from 4 to 15 days. The swellings or carbuncles on the skin are at first hard, hot, and painful. Later they may become cold, more or less painless, and gangrenous. During this time there is an elevation of temperature and possibly some intestinal and respiratory disturbance. Occasionally an animal affected with this form of anthrax will recover, but such cases are rare.

Shortly after death a bloody tar or coffee-colored discharge that does not clot oozes out of all the natural openings of the body. These discharges are loaded with the organisms that cause the disease. Soon after these growing, or vegetating, organisms are exposed to the air, they change their form very quickly and radically. They then throw a protective covering around themselves, known as a spore formation. In this form, like vegetable seeds, they will keep indefinitely—frequently many years; and again like vegetable seeds when they find conditions suitable for their growth, as in the alimentary canal of a susceptible animal or in soil, they emerge from their protective covering and begin to grow, multiplying with great rapidity.

It is never advisable for an inexperienced person to open the carcass of an animal that has died quite suddenly of a disease the symptoms of which resemble those of anthrax, for the reason that the organisms are scattered far and wide and, again, there is danger, much danger, of the person infecting himself with the disease.

There is but one positive way of identifying the disease and that is by bacteriological examination.

To send in a sample for bacteriological examination, proceed as follows: Obtain a small glass bottle (15 to 30 c.c. is plenty

large enough) and a tight fitting cork. Wash the inside of the bottle throughly. Then place bottle and cork in some clean water and boil for 10 to 15 minutes. Take the bottle out of water and after it is cool collect a small amount of blood from the dead animal, then turn the bottle around a few times in order to stain the inside of the bottle with the blood and then turn it upside down and let all of the excess blood run out. Then set the bottle in the shade and let it air dry until the blood is also dry, which may require two or three hours. Next put the cork in the bottle tightly and pack the bottle in some cotton or other suitable material and the whole in a bamboo tube, or other suitable container, after having first labeled the bottle as "Suspected Anthrax" and send same direct to the Veterinary Research Laboratory, Pandacan, Manila. At the same time send a letter to the same place giving all particulars. This laboratory service is free of charge.

After having done this burn the carcass, or bury it very deep, then cover all the ground around the place with dead grass, straw, or some other suitable material and burn it in order to destroy the infection that has been spread around. Before leaving the place have every one that has been assisting disinfect his feet, hands, and clothing if soiled with blood, with a 5 per cent solution of creolin in water.

In the meantime notify the proper municipal officials of the death of the animal. If more animals die and the report from the laboratory has been positive for anthrax, request the Director of Agriculture, Manila, to have your animals vaccinated with anti-anthrax vaccine. This service is also free of charge.

This procedure is given for the information and guidance of those that have no Bureau of Agriculture veterinarian, or livestock inspector, in their province. If there is a veterinarian available he should be notified. If there is no veterinarian available then notify the livestock inspector, if there is one in your province.

It is worse than useless to attempt to cure an animal affected with anthrax, for it can not be done. The only hope lies in prevention and that through vaccination.

HEMORRHAGIC SEPTICEMIA

This is becoming quite prevalent in the Islands, as well as in many other countries. The animals most frequently affected are carabaos, cattle, and poultry, especially chickens, although nearly all domestic animals, as well as many wild ones, are

susceptible to the disease. The organisms that cause it in carabaos and cattle appear to be identical, and the disease can be conveyed, experimentally, from one animal to the other. In most of the other animals there appears to be a special organism for each kind, and they are referred to collectively as Pasteurellosis. They are found in the blood stream as well as in the tissues of the animal affected, causing small hemorrhages in various organs and a severe toxemia, manifested by a high temperature and muscular tremors—provided the animal lives long enough. In many cases an apparently healthy animal may drop down and after a few convulsive movements of the body it is dead. Chickens that are apparently healthy when they go to roost at night may be found dead the next morning under their roost. Occasionally carabaos, particularly, are affected with a form of the disease in which large, painful, and hard swellings appear over the throat which, in many places in the Islands, is called *garrotillo* as they may become so large as to interfere with the animal's breathing and cause strangulation. Or the swellings may appear under the jaws or in the dewlap. The mortality in such cases is very high. Not all cases of hemorrhagic septicemia, however, are fatal. An animal suffering with the disease should be isolated completely from all other animals, in a comfortable place, and fed with good feed if it is inclined to eat. After the animal dies or recovers, the place where it has been kept should be burned over or thoroughly disinfected with a 5 per cent creolin solution.

The organism (*Bacterium bovisepticum*) that causes the disease in cattle and carabaos is widely distributed in nature, and is believed to enter the body by way of the digestive tract or through wounds in the skin.

There is no cure known for the disease. Good nursing and feed may assist an animal to recovery that otherwise might die.

Considerable success is claimed by the manufacturers of biologics from the use of their products, as preventives of hemorrhagic septicemia. There is a bacterin and an aggressin used for the purpose, and a special strain for every class of animals, including chickens. This disease is subject to quarantine, and should be reported.

TEXAS FEVER (TICK FEVER; RED WATER; SOUTHERN CATTLE FEVER)

Ordinarily all Oriental cattle are immune to acute tick fever, as well as the cattle in certain parts of the Southern States, and cattle in the northern part of Australia; all warm countries the

year round, where the weather never gets cold enough to kill the ticks.

Notwithstanding this fact on rare occasions an animal will come down with an acute tick fever, but a chronic form is more usual in these warm countries.

Cattle that have not been raised in tick-infested regions, or that have not been artificially immunized to the disease will, if taken into tick-infested regions, very frequently come down with the disease and die.

There have been several instances where expensive breeding cattle, from tick-free regions, imported into the Islands, without having been first immunized to the disease, have promptly come down with it and died.

The history of the cattle tick, so common in the Philippines and other warm countries, is an interesting one.

For many years it was known in the States that when Southern cattle were taken North during the summer season the native cattle in the Northern States promptly got an acute febrile disease, while the cattle from the South remained healthy. It was also known that when Northern cattle were taken sufficiently far South they, too, got the same disease, while the Southern cattle remained healthy, and that Southern cattle could be taken into the Northern States during the winter season and none of the native cattle would become sick. This peculiarity remained an enigma for many years.

It was not until 1889 that Dr. Theobald Smith of the Bureau of Animal Industry, Department of Agriculture, who, with Kilbourne, conclusively proved that the common cattle tick, known then as *Boophilus annulatus,* and now as *Margaropus annulatus,* was the specific cause of the infection.

This was probably the greatest discovery ever made in any branch of medicine, i. e., that a disease could be conveyed through an intermediary host. Since that time many dangerous communicable diseases of man and beast have been conclusively proved to be transmissible through an intermediate host; for example, malaria, yellow fever, typhus fever, and bubonic plague in man, and surra in many animals, also malignant jaundice in dogs, and spirochetosis in chickens. Not all of these diseases, however, are transmitted by ticks as some of them are conveyed through mosquitoes, some through flies, some through lice, and some through fleas.

Cattle ticks not only cause the death of susceptible cattle but they are the cause of enormous economic losses in these animals,

as they feed on them, sucking their blood and thus greatly devitalizing them physically. The ticks may also leave wounds on an animal that may become fly-blown and possibly cause its death.

The United States and Australia, and possibly other countries, are spending large sums of money to rid these countries of cattle ticks, fully realizing the enormous economic loss caused by them annually. Such a procedure, however, in the Islands would be impracticable at least for many years to come.

The immature Texas fever tick has but six legs, until it attaches itself to a congenial host, and then it molts and acquires eight legs and then, after one more molt, it is sexually mature.

It is known as a one-host tick; that is, it stays on one animal only and that animal continuously. After the female becomes fully engorged with blood she falls off her host and after depositing a large number of eggs she dies. Not all varieties of ticks, however, of which there are a very large number, transmit diseases.

ANAPLASMA MARGINALE

This disease is occasionally seen in Philippine as well as Cambodian cattle. About the first symptom that is noticeable is a lack of coördination when walking, and the drowsy appearance of the animal. These symptoms may persist for several days until the animal goes down either semi-comatose or comatose and from then into a deep coma. If the visible mucous membranes are examined at this time they will be found to be very yellow (jaundiced, icteric). The animal may remain down and in deep coma, with occasional convulsions, for several days before it finally dies.

On post-mortem examination all of the tissues are found intensively jaundiced, and the gall bladder greatly distended with exceedingly yellow bile, a feature that may be considered as pathognomonic of the disease.

There is no effective treatment known for the disease, which is believed to be conveyed by a tick, but not necessarily the Texas fever tick. Carabaos are apparently immune to *Anaplasma marginale.*

LIVER FLUKES (DISTOMATOSIS)

There are several varieties of liver flukes for the same animal, and for all classes of herbivorous animals, as well as for poultry. Some of them are responsive to treatment and some are not.

A number of cattle have died in the Islands as a result of liver fluke infestation, and the condemnation of infested livers in meat inspection during a year amounts, in the aggregate, to a big economic loss.

Cattle that are not extensively infested with flukes may show no physical signs during life, but on post-mortem examination their livers may be found to be more or less diseased as a result of the presence of, and damage done by, the flukes.

If the flukes are in large numbers they may cause the death of their host, or they may give it a general unthrifty appearance. The animal becomes thin in flesh, the hair loses its gloss and becomes long with a tendency to stand on end, which gives it a dead or weather-beaten appearance. The emaciation may become extreme and the animal have alternately loose bowels and a profuse diarrhea, possibly streaked with blood and mucus, which has a tendency to persist until the animal either improves or dies.

The malady is invariably at its worst during the latter part of the dry season when there is little or no green feed for the animals on the uplands. At this time of the year the animals will feed on the green vegetation that is growing in swamps, and that is when they become infested with the embryonic form of the flukes as these are attached to the green vegetation that the animals feed on. After the flukes in their embryonic form find their way into the intestinal tract of their host, they migrate up the gall duct and into the gall bladder and then into the bile ducts in the liver. If in sufficient numbers, they may cause severe digestive disturbances followed by the death of their host, or the animal affected.

After the flukes remain in the gall bladder and bile ducts for a certain length of time, which is several months, they disappear. In the meantime if the animals feeding in the swamps have taken in no new embryos they may free themselves of the parasites. But in the meantime the flukes in the liver have laid many eggs which may be passed with the feces when the animals are in the swamps feeding on the green vegetation. In such case another life cycle of the parasites is favored. In the warm stagnant water in the swamps the eggs of the flukes hatch. After the eggs hatch the larval form of the fluke may enter the body of a snail to spend a certain length of time, when it emerges from its host and attaches itself to the green vegetation which the animals eat and thereby infests them with the

embryonic form. Each fluke has both male and female generative organs. Unless the eggs of the flukes are deposited in water they will not hatch, as the snails (and possibly slugs) in the water are absolutely necessary in the life cycle of liver flukes. Not all flukes, however, inhabit the liver of their host as some of them in poultry live in the intestines.

Swampy lands should be drained out, or inclosed with a fence, to prevent animals from feeding on the green vegetation that is growing in them. The keeping of a number of ducks in a swamp may lessen fluke infestation to a considerable extent, as the ducks will feed on the snails and slugs which are so necessary in the life cycle of flukes.

The most important treatment of liver flukes in cattle is to prevent their re-infestation by feeding on swamp vegetation, by giving them good feed in the meantime to support their physical condition until the flukes in the liver disappear, which would be several months under the most favorable conditions.

A number of different kinds of drugs have been used for the treatment of liver flukes in cattle, among them being an extract of male shield fern (*aspidium*—used also for the destruction of tapeworms). Some claim that it has merits in destroying some, but not all, kinds of liver flukes. Others claim to have been disappointed in its administration for liver flukes. The drug is an energetic poison and, if used, should be used cautiously.

Recent reports allege that Montgomery, Simms, and others have been very successful in eliminating matured liver flukes in sheep (which would probably apply to goats) with carbon tetrachloride administered at one dose of one c.c. in suitable capsules, and then isolating the sheep from swampy areas.

The treatment might have merits in treating cattle with liver flukes, if administered in larger doses and in suitable capsules. In giving this drug much care should be taken to prevent the capsule from being broken in the mouth, as the drug is very pungent and volatile and may cause asphyxiation of the animal should any of it escape in the mouth. A refined preparation of the drug is known as tetrachlorethylene which is said to be less dangerous, but it would be more expensive.

COCCIDIOSIS

This is occasionally seen in cattle in the Islands, particularly in imported breeding animals and dairy cattle.

The first symptom of the disease that may be noticed is looseness of the bowels which may persist or progress to a profuse

diarrhea. There is some loss of appetite and more or less rapid loss of flesh, with possibly colicky pains, depending upon the severity of the affection. The stools may be mixed with blood and in this respect resemble a symptom of rinderpest. However, if the temperature is taken at this time it will generally be found to be normal, and this feature in itself plus the chronic course would serve to differentiate it from rinderpest. When there is a profuse diarrhea and consequently excessive loss of body fluids, there is invariably much thirst, and if the animal is permitted to drink all the water it wants the diarrhea will be greatly increased. Or if it is permitted to move about at this time the peristalsis of the bowels is increased and the diarrhea is thereby aggravated.

The palliative treatment is to keep the animal absolutely quiet, and in order to do this it will be necessary to tie it up, or put it in a stall, to prevent it from moving around, and give it absolutely no water whatever to drink except flour or rice-water gruel which, being thirsty, it will readily drink. In half a bucketful of flour or rice-water gruel may be given from 50 to 75 c. c. of the following mixture, three times daily, until the diarrhea subsides materially, then twice daily, to an adult "vaca," until the diarrhea has subsided completely:

℞	*cu. cm.*
Tinct. opium	āā 120
Spts. camphor	
Aromatic sulphuric acid	

Mice. Signa:

Give 50 to 75 c. c. in one half bucketful of flour or rice-water gruel, from two to three times daily.

To make a flour or rice-water gruel: boil about two liters of water, then take it off the fire and stir in either wheat flour or rice flour and stir constantly until it is about the consistency of a paste. Then pour it into a bucket and add a sufficient amount of cold water to cool it, also a small amount of salt. This may be given with or without the medicine in it.

In the meantime give the animal a small amount of good food to eat. Relapses may be expected from time to time. If they do occur repeat the same treatment.

For a positive diagnosis place a small amount of the feces in a bottle and send it to the Veterinary Research Laboratory, Pandacan, Manila, and at the same time send a letter giving all the particulars, to the same place, stating what you want the specimen examined for.

TUBERCULOSIS

This is very rare in Philippine cattle, even in a localized form, but it is very common in the localized form in Philippine hogs. It is very seldom that cattle will ever die of tuberculosis. They may have it in a generalized form, and yet be fat and healthy looking.

The best way to diagnose tuberculosis in cattle ante-mortem would be to subject them to the tuberculin test, which would necessarily have to be done by a qualified veterinarian.

NON-COMMUNICABLE AFFECTIONS OF CATTLE

TRAUMATIC PERICARDITIS

The name indicates the condition, i. e., an injury to the heart's sac (pericardium). This condition occurs more or less frequently, in dairy cows particularly. The reason for this is that dairy cows are generally kept in, or around, buildings where there is a greater possibility of nails, and particularly baling wire on hay, fodder, rice straw, etc., getting mixed in the animal's food, and therefore being swallowed with its food. The foreign substances invariably lodge in the second stomach (reticulum—which we eat as tripe) where, during the powerful contraction of the organ during digestion, they are sometimes pushed through the walls of the organ and the ends of the objects penetrate the heart's sac when, sooner or later, there may be a train of ill-defined symptoms present that are more or less difficult to interpret correctly.

The most constant symptom of the affection is a disturbed respiration, particularly if the animal is moved about, jugular pulsation extending well up on the side of the neck; a hacking cough; dropsy in the dewlap, and when standing the forelegs may be kept wider apart than normally. There may be a disinclination to move about and when the animal does move there is more or less stiffness, as though it had pleurisy. It generally lies down on one side, and if it should be the wrong side it quickly gets up, due to the pain that the foreign body is inflicting on the heart. There is a marked disturbance in the circulation which is much faster and intermittent after exercise.

If reasonably certain as to the diagnosis the treatment would be to send the animal to the butcher, as a surgical operation to remove the foreign object has little possibility of success.

ABSCESSES

Abscesses about the neck, particularly in carabaos and cattle, are of very common occurrence as a result of injuries from the yoke. They may be seen on carabaos in the streets of Manila almost daily, and many of them as large as a husked coconut, due to injuries most frequently from being struck by some moving object or from an ill-fitting yoke.

Abscesses in carabaos and cattle are invariably hard and indurated. They seldom soften and break and drain on their own accord as they so frequently will in horses. The pus in the abscesses is invariably thick.

The treatment consists in washing the abscess thoroughly with a 5 per cent creolin or lysol solution. Then wash the hands thoroughly in the same solution, also a very sharp knife, and then open the abscess freely to permit of drainage. The abscess cavity should be washed out once or twice daily with a 3 to 5 per cent creolin, or lysol, solution, and a little pine tar daubed on the outside of the wound to keep the flies away. An animal with an abscess will do no good as a rule from a physical standpoint, as it is constantly absorbing the toxins from the abscess.

FILARIA LACHRYMATIS

This is a slender round worm varying from one-half to one inch in length that is quite frequently found on the surface of the eyeball in carabaos and less frequently in cattle, which is believed to be related to the worm that causes gapes in chickens. It may be readily seen, and frequently causes an inflammation of the conjunctiva.

A treatment that has been used in the Islands for this affection that is recommended by the Bureau of Animal Industry, U. S. Department of Agriculture, as very successful in curing cases of this kind, consists of washing the eyes with a weak antiseptic solution (4 per cent boric acid in water, would answer the purpose) and then applying an iodoform ointment to the eyeball, in the official 10 per cent strength.

Filaria oculi, sometimes called "snakes in the eyes," has been discussed under the heading, "Periodic Opthalmia In Horses." In this affection the worm is in the anterior chamber of the eyeball, and sets up an inflammation known as a *keratitis*. The treatment for this affection is surgical, and should be given by a qualified veterinarian.

BROKEN HORNS

Carabaos and cattle frequently receive an injury to a horn, either breaking it off completely or causing a detachment of the horn from the underlying horn core. If the horn is broken off completely, the end should be daubed over several times daily with pine tar to keep the flies away. Many people, under the circumstances, prefer to amputate both horns in order to maintain a symmetrical appearance of the head. Then the stubs of the amputated horns should receive an application of pine tar several times daily. If the horn core has not been broken off it should receive a thick coating of pine tar, be wrapped in absorbent cotton, and a bandage put over this. Re-dress the horn core the same way every three or four days, after having first washed it off gently with some weak antiseptic like a 2 per cent creolin solution in water. In the course of time the horn core will throw out an exudation that will gradually harden and thereby protect the sensitive parts underneath, and the general appearance of the animal will not be greatly altered as a result of the injury.

COMMUNICABLE DISEASES OF SHEEP AND GOATS

STOMACH WORMS

There are several varieties of stomach worms in sheep and goats, but as the same treatment will answer the purpose for all of them they will not be classified as to variety.

If animals are infested with stomach or intestinal worms in such numbers as to be deleterious to their health, they will present signs of a progressive unthrifty appearance. The hair loses its natural gloss, the visible mucous membranes are pale, and the animal may have attacks of colic from time to time. If the worms are in the intestinal tract there may be a looseness of the bowels possibly mixed with blood amounting to an actual diarrhea.

If there is any doubt about the parasitic infestation in a herd or flock, it would be advisable to kill one of the worst affected ones and make a very careful post-mortem examination, by opening up the intestines their full length, then opening the stomach, also the bile ducts in the liver for possible liver fluke infestation. If any worms are found in the intestines or in the stomach put a few of them in a small bottle, then fill bottle with alcohol and label the bottle as to where the worms were found, and send it to the Veterinary Research Laboratory, Pandacan,

Manila, for identification of the parasite. At the same time send a letter giving all particulars to the same address. There will be no charge for this service.

The treatment for stomach worms in sheep, goats, and cattle is the same, with the exception that the size of the dose varies for the different animals and even for the same animal, depending upon age.

Hall recommends copper sulphate (cupri sulphate; blue vitriol) for the treatment of stomach worms (*Hæmonchus contortus*) in sheep, goats, and possibly cattle as follows:

Copper sulphate, one per cent solution in water, to animals fasted overnight; if used as a routine repeated treatment, animals need not be fasted. For sheep, 100 c. c. (3.5 fluid ounces), for lambs, 50 c. c. (1.75 fluid ounces). No purgation. Worms pass for four days. Efficacy, 93 per cent as indicated on the basis of worms passed and worms present postmortem. The doses which are given here may be (and should be) repeated at intervals of three to four weeks throughout the year in places where stomach worms are prevalent (which means here wherever the animals have grazed, for the reason that this is an unfenced country).

The one per cent solution may be made up at the rate of one gram of powdered blue crystals of copper sulphate to 99 c. c. of water, or, for large amounts, one-fourth pound of copper sulphate dissolved in one pint of boiling water, with cold water added to make a total of three gallons, enough to dose 100 adult sheep (or goats) and allow 10 per cent waste (this treatment is not expensive).

Another treatment consists in using a solution containing one per cent of copper sulphate solution and one per cent by weight of powdered tobacco. The tobacco is steeped in water overnight and the copper sulphate then added. The dose and method of treatment is the same as for the copper sulphate treatment given above. The reported efficacy is 90 to 100 per cent.

The same treatment may be administered to cattle for the same kind of worms in doses varying from 100 to 300 c. c. depending upon the age of the animal. For instance, calves 100 c. c., yearlings 150 c. c., and adults 300 c. c.

The copper sulphate solution and tobacco treatment administered in the same doses and manner as for stomach worms are said to be very efficacious in the treatment of hookworms (blood sucking parasites and very dangerous tenants), also for tapeworms in the same animals and in the same doses as given above.

GID OR TURNSICK

This is occasionally seen in Philippine sheep and goats, less frequently in cattle. It is caused by a tapeworm cyst (*Multiceps multiceps* or *Cœnurus cerebralis*) or intermediate stage of a tapeworm which lives, when mature, in the intestines of dogs and other species of canines.

The eggs of the tapeworm are scattered about in the feces of infested dogs and when swallowed in food or water by sheep, goats, or cattle, hatch out and the embryos migrate to various parts of the animal's body, including the brain, where they may develop into cysts. The dogs are infested by eating the raw parts of the animals that may be infested with the cysts that develop into mature tapeworms in their intestines, and thus another life cycle of the tapeworms may be started.

If the cysts form in the brain of an animal they will cause a brain disturbance characterized by the animal holding its head to one side and possibly walking around in a circle, hence the name "turnsick." In man they are known as hytadid cysts.

The treatment is not very promising. It consists of first finding the exact location of the cyst and then trephining and liberating the cyst with its embryonic tapeworm contents, which is not possible to do in many cases. It would be safer, and probably more profitable, to send the animal to the butcher. In such a case the head, as well as any other parts that may contain cysts, should be condemned, and destroyed in order to prevent further infestation of dogs.

FOOT-ROT IN SHEEP AND GOATS

Sheep are very susceptible to foot-rot; goats less so. The disease is favored by rainy weather when the ground is soft, also by insanitary corrals and environments. It usually begins at the coronary band and then small ulcers that discharge a purulent secretion form at the heels and between the hoofs. The disease may progress until the entire foot, or several of them, is involved in the necrotic process. The cause of the disease is generally believed to be an infection primarily with the necrosis bacilli and the lesions are invaded secondarily by a variety of pus-producing organisms.

The successful treatment of foot-rot may be extremely obstinate. It would be advisable to separate the affected animal, or animals, from the non-infected ones, for convenience in treating them and lessening the danger of the disease to the non-infected animals. The corrals in which the animals are kept should be dry and clean at all times.

The medicinal treatment is empirical and very problematical. One of the following treatments is suggested:

Keep all diseased horn pared off closely at all times and the feet as dry as possible. Pearson's creolin, *undiluted,* may be applied once daily with a swab. Or refined oil of pine tar con-

taining about one per cent of formaldehyde. Or the affected parts may be swabbed once daily with from 10 to 20 per cent methylene blue solution in water. A weak acid solution in water, such as *tuba* vinegar about 10 to 15 per cent, or about a 2 to 5 per cent solution in water of glacial acetic acid may also be tried.

If the one per cent formaldehyde in refined oil of pine tar hardens the tissues too much reduce the amount of formaldehyde in the oil of pine tar and apply less frequently.

The *Necrosis bacilli* that is believed to cause the disease is found widely distributed in nature, and is also believed to be the specific cause of numerous diseases as necrotic stomatitis in calves, gangrenous dermatitis so frequently seen in a large stable of horses, also thrush and canker of the feet in horses that are kept under like conditions, as well as a number of other diseases.

FLY-BLOW

Sheep, as well as goats, on receiving a break in the skin, frequently get fly-blown, and if not treated promptly many cases will die. It is said that fly-blow causes the death of more sheep in Queensland than all other affections combined.

The treatment of fly-blow has been given under "Non-Communicable Affections of Horses." The same treatment may be used for any animal.

MANGE (SCABIES)

There are several varieties of the mange mite that affect all classes of mammals, including man.

All of the varieties are more or less difficult to eradicate, but some of them are more so than others. In sheep and dogs there are species known as psoroptic in the former and demodectic or follicular in the latter that are particularly obstinate to deal with successfully.

To find the mange mite get a dark or black colored piece of paper and scrape some of the scales and scabs off the infested animal onto the black paper, and then place the paper containing the scrapings in the sun. After the mites become warm from the sun they may be seen moving about on the paper as small light colored objects or points.

Their presence on an animal for any length of time is indicated by bald spots from loss of hair and more or less itching, which causes the animal to rub or scratch the parts. In the course of time they injure the tissues from the frequent rubbing

or scratching, which causes scabs to form, from which the disease derives its name, and the animal's physical condition becomes worse and worse until an extreme stage of emaciation results and finally death.

Sheep that are infested with mange should be sheared before the treatment is begun, in order to remove the wool which may afford protection to the mange mite during the treatment.

There are several formulas recommended by the U. S. Department of Agriculture for sheep and cattle dips. As each one requires special care in its preparation and administration in the treatment of mange in the different domestic animals, none of them will be quoted here but will be given to meet special conditions upon request.

The follicular variety of mange in dogs, so common in the Islands, is anything but encouraging to deal with. Recently an apparently hopeless case of the disease in a pet dog, that had run the gauntlet of treatments, was given intramuscular injections of sulpharsphenamine with very gratifying results after having received six intramuscular injections, of gradually ascending doses of the preparation, given every four days.

The results should not be interpreted, however, as a cure. There is a possibility that the apparent benefits will be only temporary, and that the disease will eventually reappear, as it does after any other kind of treatment. If the treatment has any merits it might be used to advantage in individual treatment of large animals, for mange, as in the case of a stallion, bull, or ram. It would be too expensive to treat a large number of animals having but nominal values.

The great difficulty in dealing with mange is to prevent reinfestation of the animals with the mange mites which may be left on anything that they have come in contact with before treatment. This problem is particularly difficult to overcome in treating dogs. They not only lie around on infested floors and grounds, but the possibilities of their coming in contact with other dogs that are mangy constitutes a problem very difficult to overcome.

RESPIRATORY DISEASES

Goats, and less frequently sheep, are affected with respiratory diseases. Particularly is this the case with goats during the rainy season when they are exposed to rains and get wet.

Generally the affection starts as a cold (influenza) affecting the upper respiratory passages, characterized by snuffles and sneezing followed by a serous and then by a sero-mucous and

possibly a muco-purulent discharge from the nostrils. If the disease progresses to a favorable termination the discharge soon ceases and the animal's health returns to normal. Not all cases, however, terminate so favorably. The disease may extend to the lungs by way of the lymphatics and blood-vessels (*metastasis*) and produce a pneumonia which, in nearly all if not in all cases, terminates in death.

Goats, as remarked elsewhere in this article, should have perfectly dry and sanitary shelter to protect them during rains and storms and, like cats, they do not have to be told to come in or out of the rain. Neither animal will voluntarily get wet if there is any way to escape doing so.

INFLAMMATION OF THE INTESTINES (ENTERITIS)

There have been several deaths of goats reported as having died of enteritis. It is not known whether or not the deaths were due to coccidiosis, or to other causes.

Sheep and goats are susceptible to anthrax, hemorrhagic septicemia, rinderpest, and foot-and-mouth disease. As these diseases have been discussed under their respective headings as diseases of cattle, they will not be repeated here, as the measures and treatments recommended apply also to sheep and goats.

There are many sheep and goats killed in the Islands every year by dogs. Several years ago on a large cattle ranch in one of the Southern islands many pariah dogs found their living on the ranch by killing new-born calves and, frequently, their mothers also, if they were down and unable to get up or were otherwise too weak to defend themselves from the dogs.

COMMUNICABLE DISEASES OF SWINE

HOG CHOLERA

So far as known hog cholera was first reported in the Islands in 1904. Since this time it has been frequently reported from time to time in various localities in the Islands. It is not to be taken for granted, however, that the disease did not exist in the Islands prior to this date.

At one time hog cholera was believed to be due to *Bacillus suisepticus* a short rod-shaped actively motile organism, but it is now thought to be due to a filterable virus. The period of incubation may vary from 5 to 10 days. The virus that is believed to produce the disease is carried by various means from place to place and may contaminate the food and water taken by a healthy animal and thereby infect it with the disease.

Hog cholera may appear in the acute or chronic form. In the acute form the animal usually dies in from four hours to three days. During this time the temperature may be 40° C. or more. There is complete loss of appetite, and in the early stage there is constipation which is later followed by a profuse, fetid, and possibly bloody diarrhea, if the animal lives long enough. The eyes are congested, and intolerant of light, followed by a profuse secretion which may glue the eyelids together. The respiration is labored and rapid and frequently accompanied by a slight or suppressed cough. Red blotches frequently appear on the skin, which may increase in size, and desquamation of the epithelium over the red blotches take place, forming scales or flakes before they are shed. There is a marked nervous disturbance with muscular incoördination and progressive weakness.

The chronic form usually occurs in the older animals and may last from three to four weeks. In this form the symptoms are not as severe as they are in the acute form but they are more prolonged. Emaciation, however, is constant and rapid. While some animals may recover from the disease in this form, they will always remain unthrifty and practically worthless.

About 80 per cent of all hogs in a lot infected with hog cholera will come down with the disease, and of this number about 90 per cent will die.

The well animals should be separated from the sick ones. It would be best to destroy all sick ones and cremate them or bury them deep, together with all the discharges in the pen. Then thoroughly disinfect the pen, both walls and floor, and feed troughs and everything that has come in contact with the sick animals. For this purpose a 5 per cent creolin solution in water may be used. The person who takes care of the sick animals should thoroughly disinfect his feet, hands, and clothing with the creolin solution before going near the well animals, in order to prevent him as far as possible from carrying the infection to them.

The post-mortem findings in a hog that has died of cholera will vary in accordance with the duration and severity of the disease. If the animal dies within a few hours the mucous membranes of the intestines may show more or less congestion, and small hemorrhagic areas in the serous membranes. The lymph glands are found to be enlarged and hemorrhagic on section. The heart muscle shows small hemorrhagic areas. The skin may show red blotches, particularly between the thighs, on

the abdomen, and on the ears. The marrow in the hollow bones may vary in color from a dark red to black.

In the more chronic form of the disease ulcers may appear in the throat and in the mouth, and particularly in the small and large intestines. These ulcers are usually circular in outline, with a thickened border and depressed center (known as button-shaped) and will vary in size and color from yellow to a dark blue. They are usually confined to the mucous and submucous tissue, but it is not uncommon for them to penetrate through the intestinal wall. If the kidneys are stripped of their capsule they will be found studded with small hemorrhagic areas, which gives them a mottled appearance like a turkey's egg. This symptom is considered as pathognomonic of hog cholera. The small red (hemorrhagic) blotches on the skin have greatly increased in size in the chronic form of the disease. This condition is particularly noticeable if the animal has been slaughtered, scalded, and the hair removed.

Hog cholera and swine plague often exist in the same animal at the same time.

No cure is known for the disease after it has once developed. The only hope lies in prevention by isolation and hygienic measures. In some countries immunization is practiced very extensively, and with very satisfactory results. Immunization is not a cure; it is intended as a prophylactic, or preventive, only.

SWINE PLAGUE

Is a dangerous communicable disease of swine, caused by *Bacillus suisepticus*, a short non-motile organism that stains at both ends (bipolar), belonging to the general class of septicemic organisms, known collectively as *Pasteurellosis*. This group of organisms is widely distributed in nature, and certain kinds for certain classes of animals, including poultry. Under favorable conditions certain kinds or strains become pathogenic for a certain class of animals. Man appears to be immune to this particular group of organisms.

There are two forms of the disease, i. e., the pulmonary and the hemorrhagic. The period of incubation is from 4 to 14 days. This disease, like hog cholera, may run an acute or chronic course. The acute form will ordinarily run its course in from four to eight days.

The disease is ushered in with a chill, followed by a cough and elevation of temperature, loss of appetite, difficult breathing, and constipation which in some cases may be followed by a diarrhea.

In this disease as in hog cholera there is a congestion followed by inflammation of the conjunctiva of the eyes, accompanied by a discharge, and intolerance to light. There may also be reddish discoloration of the skin in places where the skin is thin, as between the thighs, under the abdomen, and on the ears.

In the chronic form the animal may live from 8 to 14 weeks, with a modification of all the acute symptoms just detailed. The mortality in swine plague will average from 80 to 90 per cent. At one time the disease was believed to be a form of hog cholera, but the microörganisms that are associated with the two diseases are very different, as well as the post-mortem lesions. In hog cholera the digestive tract is principally involved, while in swine plague it is the respiratory tract.

However, the post-mortem lesions may vary considerably, but as a rule the lungs are primarily affected, particularly the anterior lobes. They are usually hepatized and firm to the touch. The pleura is thickened, its normal lustre lost, and is often studded with yellowish patches. On the cut surface the lung presents irregular mottling. In prolonged or chronic cases there are necrotic areas with cheesy deposits sometimes from one to two inches in diameter. The bronchi are often filled with a whitish pus or a reddish froth. The peritoneum is often inflamed and covered with a fibrinous exudate. The intestinal mucous membrane is often congested and sometimes ulcerated. The ulcers are depressed, and not raised above the surrounding structure as they are in hog cholera.

There is no cure for the disease after it has once developed. The same precautions as to isolation of the healthy animals, destroying the sick ones, disinfection, hygiene, cleanliness, etc., as recommended for hog cholera, are advisable.

Ordinarily the disease does not progress to the proportions of an epizoötic as does hog cholera. There may be but one case or only a few in a locality.

Immunization is practiced extensively in some countries for the control of swine plague, as with hog cholera, with more or less satisfactory results.

TRICHINOSIS

This is due to *Trichinella spiralis* (*Trichina spiralis*) a round worm that becomes encysted in the muscles of its host.

The animal that most frequently harbors and distributes the parasite is the rat. All omnivorous and carnivorous animals,

such as hogs, dogs, cats, etc., that may eat an infested rat are potential carriers of the embryonic form of the worm which becomes encysted, or encapsulated, in their muscles.

If a man eats the cysts containing the embryo worm as is sometimes done in eating pork that has not been sufficiently cooked to destroy the encysted parasite in the muscles he may become infested with *Trichina spiralis* and possibly die, with symptoms of typhoid fever.

The encapsulated trichina may be found, on microscopical examination, in the tendinous insertions of muscles of infested animals.

The way to prevent the infestation of swine with *Trichina spiralis* is to prevent them from eating the flesh of infested animals, particularly the rat.

To prevent the infestation of man with *Trichina spiralis* the pork should be thoroughly cooked before it is eaten, in order to kill the embryonic form of the parasite encapsulated in the muscular tissue.

The alleged trichinosis of some people in Europe as a result of eating imported American pork precipitated a Federal Meat Inspection System that has been built up and perfected to a very high degree of efficiency at the present time. However, the microscopic examination of pork for export, for *Trichina spiralis,* is no longer practiced by the Federal Meat Inspection Service, as the practice has been discontinued for a number of years, as being impractical and unnecessary.

KIDNEY WORMS (*Stephanurus dentatum*)

There is an extensive and widespread infestation of Philippine hogs with kidney worms. A large number of hogs slaughtered in the City Matadero, Manila, are found on post-mortem examination to be infested with the parasites, the infestation varying in extent from mild to extensive, yet the animals may not show any ante-mortem symptoms of the affection.

The clinical symptoms of the disease, when present, before death are more or less loss of coördination in the hind quarters, which may persist or increase to a complete paralysis a few days before death. There may or may not be loss of flesh. The most constant clinical symptom is a wabbly gait when walking, and a tendency to weave from side to side in the hind quarters when standing. The appetite is not much affected, until just before death. Comparatively few of the animals in-

fested die of the disease, and they may not be suspected of being infested until the parasites are found on post-mortem examination. The favorite location of the worms is in the kidneys, although they may be found in various other parts of the body.

On incising the capsule of the kidneys they may readily be seen as mottled black and white worms about one-half inch long, slightly tapering at both ends, more or less embedded in the kidneys, and under their capsules. It is not unusual to find evidence of old tracts in the kidneys that were made by worms that have died and been absorbed or have undergone calcareous degeneration.

If the worms have done sufficient damage to the kidneys, thereby interfering with their function of eliminating urine, the carcass of the animal may have a characteristic disagreeable odor due to uremia.

Nothing is known as to the life cycle of the worm, and consequently the only suggestion that can be made to lessen the possibilities of infestation by the pigs is to keep their pens clean and sanitary at all times.

TUBERCULOSIS

This disease in a localized form is quite common in Philippine hogs. The tubercular abscesses are most frequently found in the lymph glands in the head, particularly the submaxillary, sublingual, and retropharyngeal, less frequently in the liver. The pulmonary form of the disease is very uncommon, and a generalized form of the disease even more so.

On meat inspection, and that is when the cases are discovered, the tubercular lesions are dissected out, if in the head, and the head thoroughly cooked before it is permitted to go out, as inspected and passed, for food. If there are tubercular lesions in the liver, the organ is condemned and destroyed. The economic loss from condemned parts for tuberculosis in hogs as a result of a careful post-mortem meat inspection is considerable. Notwithstanding this fact the consumer of pork has a perfect right to insist that his health be safeguarded when he pays his money for food that he has every right to expect is free from disease and perfectly wholesome for himself and family to eat.

The clinical diagnosis of tuberculosis in hogs ante-mortem is practically impossible without the use of the tuberculin test, and this should be made by a qualified veterinarian.

MEASLY PORK (*Cysticercosis*)

A little less than 1 per cent of all the hogs that are slaughtered in the public slaughterhouse in Manila are found on postmortem meat inspection to be infested with the cystic form, known as *Cysticercus cellulosa,* of an intestinal tapeworm found in man and known as *Taenia solium,* also as the hermit tapeworm.

The hogs are infested by eating the segments of the tapeworm that are passed by man. After the segments of the worm which contain the ova are ingested by the pig, the shell of the ova is dissolved in the digestive juices of the pig and a six-hooked embryo is liberated. The embryos now liberated in the intestines of the pig penetrate the intestinal wall and migrate through the circulation and otherwise into the tissues of the animal. Those that do not locate in the muscular tissue do not thrive. After the embryo finds lodgment in the muscular tissue there is a cyst or bladder formed around it which contains a fluid in which the embryo floats. The cysts vary in size from the head of a pin to the size of a pea. If a person eats the cysts that have not been cooked long enough to destroy the embryo, another life cycle of the tapeworm is in the making.

Every segment of a tapeworm is both male and female and one matured segment that a pig may eat may contain from 10,000 to 30,000 ova or eggs.

There is another kind of tapeworm that affects beef, that has practically the same kind of cycle as the one affecting pork. It is known in its matured tapeworm form in the intestines of man as *Taenia saginata.*

The favorite location for the cysts of the tapeworm in both hogs and cattle are the muscles of the jaw. On meat inspection the heavy muscles are freely incised and if the cysts are present they may be readily seen with the unaided eye as small semi-transparent, whitish nodules varying in size from a pin head to that of a pea.

The entire carcass of an animal found infested with *Cysticercus cellulosa* is condemned and destroyed, as the infestation is not confined to the muscles of the head but may be in any muscular tissue in the body, including the heart muscle.

Sharp hog buyers, especially Chinese, who handle most of the pork in Manila, will frequently examine a hog before purchase for *Cysticercus cellulosa,* by pulling its tongue out and palpating

the frænum for the cysts. Sometimes they succeed in detecting the infestation ante-mortem in this way, but they often fail to do so.

It is said that beef tapeworm infestation in man is more common in the Philippines than pork tapeworm due, no doubt, to the general practice of all nationalities of cooking fresh pork thoroughly before eating it.

PNEUMONIA (LUNG FEVER)

Inflammation of the lungs in swine occurs rather frequently, but is generally secondary to some other affection. There are a number of classifications of pneumonia such as metastatic pneumonia, secondary to influenza, etc. A pseudopneumonia has been seen in swine in the Philippines caused by an organism that will remain alive and actively motile under a cover-glass preparation for days.

The treatment of pneumonia in swine is not encouraging under any circumstances, as the cause, possibly influenza, swine plague, hog cholera, or whatever it may be, of which it is but a secondary stage is in itself incurable.

URTICARIA (NETTLE-RASH; HIVES)

This occurs quite frequently in swine as a result of some dietetic disorder, and is of interest to us mainly from the standpoint of meat inspection.

In itself urticaria is not necessarily fatal, but depends upon the severity of the digestive derangement. Ordinarily the affection will clear up of its own accord, but a cure can be greatly assisted by giving the animal a purgative, such as Epson salts, or jalap, and cleaning the pens and giving the animal good food to eat.

The lesions on the skin consist of weals that are red, circumscribed and itchy.

After the animal has been slaughtered, scalded, and the hair removed, the red, circumscribed weals are particularly noticeable. The carcass may be passed for food, if otherwise good, after the skin has been removed.

The affection is also known as diamond skin disease.

WORMS (INTERNAL PARASITES)

This term would include a great variety of affections, some of which have already been considered under the headings of stomach worms, liver flukes, and tapeworms. In order to deal

with worms successfully it is necessary to know the variety and life cycle of the particular kind that we are dealing with, as their life cycles differ as greatly as does the treatment for each variety.

Generally speaking, all of the most efficacious drugs used as anthelmintics or vermifuges are poisonous, and should be used cautiously. There are several varieties of vermifuges for nearly every species of worms, and the best results are obtained when the animal has been kept fasting for a certain time and the administration of the drug or combination of drugs is preceded and followed by a purgative. This is not an easy procedure to follow in medicating a number of animals. Again, one treatment is seldom, or never, sufficient for most internal parasites. One must know the life cycle of the particular parasite in question in order to select the proper drug or drugs and time the administration of them with the necessary follow-up treatment.

The most common intestinal parasites of swine, as with most other animals, are the ascarids. They are white or pinkish-white worms varying in length from 6 to 12 inches. They are usually found in the intestines, both small and large, and may migrate under certain conditions to the stomach. After the death of an animal they may penetrate through the wall of the intestines and be found free in the abdominal cavity.

They do not suck the blood of their host but obtain their nutrition by absorption. The eggs of the female are passed with the feces of the host and are hatched outside of an animal, and may then be ingested with the food or water of an animal that is to be their host.

The symptoms of ascarid infestation are the occasional passing of the worms with the feces and if there is a heavy infestation there is a more or less unthrifty appearance of the animal. Light infestation by the worms does not appear to do much harm to their host.

Santonin or spigelia are both used extensively with some animals for the treatment of ascarids. These are both poisonous drugs and the size of the dose varies with the size of the pig or hog to be treated. Tartar emetic is used for the treatment of ascarids in horses, which they will readily eat if it is placed on their feed.

Tartar emetic will not, nor will any other emetic, vomit a horse, carabao, cow, sheep, or goat, for the reason that these animals, all herbivorous, have no vomiting center in their brains.

For a simple, cheap, and fairly efficacious treatment for ascarids, or round worms, in swine give them access to a pile of soft (bituminous) coal and let them eat it at liberty. If soft coal is not available you may give charcoal, but it is not so effective. To prevent reinfestation keep the floors of the pen clean at all times, and disinfect them from time to time with a 5 per cent solution of creolin in water.

BITING (WINGED) PESTS

Fortunately we do not have a great variety of them in the Philippines, and they are not of such economic importance, with the exception of *Tabani striati,* as the non-winged biting pests like the cattle tick (*Margaropus annulatus*), and to a much less extent lice, mange mites, etc.

Mosquitoes are particularly annoying to thin skinned horses and cattle. If a thin skinned horse is tied overnight where there are many mosquitoes the next morning it will be studded with small droplets of dried blood that has oozed out of the punctures made in the skin by the mosquitoes.

The common stable flies (*Stomoxys calcitrans*) are present in stables, but in limited numbers, and they do not cause much annoyance to the horses that are kept in the stables, provided that all of the litter in the stable is removed to a considerable distance every day, and the stable kept strictly clean. The number of stable flies in a stable would be considerably reduced if the stables were kept dark, as the stable fly does not feed in the dark.

The most important biting fly that we have in the Philippines from an economic standpoint is *Tabani striati.* It is about the size of the green-headed horse flies that are prevalent in some countries, and is a vicious blood sucker. It is believed to be the chief, if not the only, carrier of surra from an infected to a non-infected animal. It has also been suspected of conveying anthrax and hemorrhagic septicemia but it has not been positively proved that it does. Its favorite habitat is near the water in cogonales. It is seldom if ever seen at any considerable distance from water, which is absolutely necessary for its breeding requirements.

The hornflies (*Lyperosa irritans*) are very prevalent here. They are blood suckers and greatly annoy carabaos and cattle, and horses to a less extent. They may be seen at times in swarms hovering around and on the heads of carabaos and the animals, if in the water, will frequently dip their heads to temporarily

relieve them from the pests. On the cattle ranges they are prevalent in enormous numbers and between them and the cattle ticks and the mosquitoes, all of them night feeders, the cattle have a difficult time of it to hold their own physically. The flies as well as the mosquitoes do not like smoke, which explains why cattle will voluntarily come into a corral in the evening and quickly bed down for the night in perfect contentment if a smoke is provided for them, or better still several smudges or smokes.

There are no fly repellants known that will keep the flies off an animal for any length of time, and if oily preparations are used they will sooner or later gum up the hair and cause an inflamation of the skin, particularly so if the animal is permitted to be out in the sun much of the time. Again, such measures would be too costly and impractical to be applicable to a large herd of range cattle.

The flies breed in the stools of the cattle, and the more cattle the more feed for the flies, and the more stools for them to breed in—an ideal arrangement for the flies.

To eliminate the flies it would be necessary to eliminate their food supply, the cattle, or their breeding places. To attempt to destroy the stools, the breeding places of the flies, from a large number of cattle scattered over an enormous territory would be utterly impracticable and impossible of accomplishment.

This may give us a slight insight of what the entomologists have been telling us: "That the future peril of mankind is neither war nor pestilence but famine, as a result of insects destroying the food supply." The insects, or many of them might be starved out first, if man would can and store his food for a number of years and not grow anything for the insects to live on. But this would be crossing the bridge before we get to it and therefore we pass the baffling problem along to posterity.

CASTRATING

This operation is a very simple one, and a little practice will make perfect. All that is needed for ordinary castration is a basin, a little lysol or creolin, and a sharp knife. For small animals like hogs, very young calves, sheep, and goats no ropes are needed, simply have some one hold them for you. For horses, carabaos, and good sized calves ropes with which to throw and tie them are necessary.

After the animal is in position wash off the scrotum with a 3 per cent lysol or creolin solution in clear water, in a clean basin. Then put the knife, that is perfectly clean, in the lysol or creolin solution and let it remain there while the hands and arms are being well washed in the lysol or creolin solution, after first having cut the finger nails short.

Then make a bold and free incision the entire length of the scrotum, and to its very bottom, parallel with the seam on the scrotum and about one inch from it, when the testicle will pop out, but still attached to the scrotum with its muscles (cremaster), and the cord, which contains the artery and veins and vas deferens, which extends on up into the abdominal cavity. Then cut the muscle off close to its attachment to the scrotum. Then pull the cord, containing the blood vessels, down and cut it off *high up* and then there will be but little bleeding. For horses, carabaos, and cattle, after the two latter have become two or more years of age, you may use an emasculator or an écraseur although adult carabaos and cattle may be safely castrated if the cord is taken off *high up* without the emasculator or écraseur. The emasculator, or écraseur, should be used for horses of all ages, and the cord pinched off with one of these instruments high up. After the testicles are removed, in any animal, make the cut longer in the scrotum, from end to end, and to its very bottom, in order to permit of perfectly free drainage for the blood and the pus that will form later. Do not overlook this little detail, for it is the secret of successful castration of any mammalian animal.

After castration do not put anything in the wound—absolutely nothing. The following day, you may smear some pine tar on the edges of the wound, which should be repeated once or twice daily if in a blue-bottle fly locality, until the wound has healed and ceased discharging. The incision made in the scrotum will have almost closed by this time. Have no fear that it will not close; only too frequently it closes before the cord has ceased discharging and consequently there is not a free exit for the pus, and then bad results may follow. Should the wound become fly-blown treat it as suggested under the heading "Fly-Blow." Should there be a thin and slightly bloody drip and the animal tries to get at the wound with its mouth it is an almost certain indication that the wound is fly-blown and needs attention.

The bungling work that we so frequently see in pigs, as a result of improper castration, and less frequently in large animals, is due to making as small a cut in the scrotum as pos-

sible in order to squeeze the testicle out, and then cutting the cord off near the testicle. Many animals die as a result of this kind of work, as much swelling takes place in the scrotum and the small incision in it closes and the pus can not find a drainage outlet. This condition may kill the animal or, if it does not, a tumor frequently forms on the end of the cord, due to infection with *Botryomyces ascoformans,* which has a tendency to persist or grow, and possibly to a very large size. The animal will frequently die as a result of the tumor or if it does not it had just as well die. The treatment for the condition is surgical and consists in dissecting out the tumor, but frequently the remaining part of the cord is greatly enlarged and extends up into the abdominal cavity. In such a case there is little to be expected from an operation as the animal's condition is a hopeless one from a surgical standpoint and from the infection causing the condition.

By making a free incision in the scrotum, from end to end, and taking the cord off *high up,* as above suggested, there need be no fear of a tumor formation (champignon) ever occurring on the end of the cord.

After castration of carabaos and horses it would be well, as a routine practice, to give them at least 1,000 antitoxin units of antitetanic serum to guard against the possibilities of tetanus (lockjaw), as the organisms that cause the disease are widely distributed in nature and may be found nearly any place in the soil; and to tie the carabaos out to graze in order to prevent them from going into filthy mud wallows.

For horses that swell up in the scrotum and insist on standing quietly as a result of the soreness, force them to take exercise until all of the swelling has disappeared. If they have been broken to ride or drive use them in this way, at a slow trot, every day until all the swelling is gone. It may take 10 or it may take 20, or more, kilometers of exercise every day to keep the swelling down. The amount of exercise is determined by the size of the swelling, and should be kept up until the swelling has entirely disappeared, regardless of the distance traveled.

The question is frequently asked, "When is the best time to castrate an animal?" The answer to the question is invariably, *Now*—providing, there is no typhoon on at the time. There is an old saying that has been handed down for generations that: "An animal is never too young, or never too old; and that the weather is never too hot, or never too cold, for castrating".

As a general practice all farm animals like carabaos, horses, cattle, sheep, and goats should be castrated by the time they are from three to six months old, and then you will make no mistake. Pigs should be castrated by the time they are from three to four weeks old, which is before they are weaned. Castrate them *now,* should be the livestockman's (your) motto, for by to-morrow the scrub bull may have done you irreparable damage.

COMMUNICABLE DISEASES OF POULTRY

CHICKEN POX (CONTAGIOUS EPITHELIOMA)

This is very prevalent in chickens in the Philippines. If it occurs in other classes of poultry in the Islands it does not do so very frequently. Young chicks are more susceptible than matured birds.

The first symptom that may be observed in young chicks is that they are not so lively as others in the same flock, and do not respond so readily to the call of their mother for food. Within a day or so if the head is examined carefully very small and hard nodules may be felt under the skin. They quickly increase in size and may become as large as a pea. Very frequently they form on the eyelids on one or both sides of the head and cause much edema of the lids as a result of the inflammatory action. After the epithelial-like nodules on the head become well developed they are more superficial and look somewhat like warty growths. The conjunctiva of the eyes may become more or less inflamed and secrete a sticky exudate that glues the eyelids together. As a result the secretions accumulate underneath and may cause bulging of the lids. This condition may cause ulceration of the cornea covering the eyeball and escape of the fluid in the anterior chamber of the eye, or a general inflammation of the eyeball (panophthalmitis) may result, causing complete or partial blindness in one or both eyes.

Other nodules may form near the natural openings of the body, or under the wings, or other unfeathered places.

If the nodules are confined to the skin spontaneous recovery frequently occurs in many cases in from three to five weeks.

If one or both eyes are involved, which may result in partial or complete blindness, it would be advisable to kill the chick or chicks and cremate them; for if by any chance they recovered from the disease they would be greatly handicapped in trying to find a living and would be objectionable among a flock of good birds.

The nodules on the skin may be cauterized with a stick of silver nitrate, using a holder or forcep in order not to cauterize and blacken the fingers. If the caustic is dry and the surface on which it is to be applied is also dry, it would be advisable to dip the end of the silver nitrate in a little water in order to make it more effective. Then next day apply a little vaselin to the cauterized surface.

FOWL DIPHTHERIA; DIPHTHERIC ROUP

These two affections are believed by some authorities to be caused by the same agent as the one causing chicken pox, differing only as to location.

In the diphtheritic form of the disease membranes form that are very adherent to the subjacent tissues on the mucous membranes in the mouth, throat, nose, and in the air cavities in the head, as well as the mucous membrane (conjunctiva) covering the eyeballs and under the eyelids. An involvement of the mucous membranes of the intestines may also occur in the disease, which is manifested by a profuse and fetid diarrhea.

When the membranes are formed in the mouth or throat they may appear as yellowish-white deposits. If they are forcibly removed they leave a raw and bleeding surface, on which new membranes are quickly formed. As the disease progresses the breathing and particularly the swallowing becomes very difficult. The bird may keep its neck extended, to favor breathing, and the beak partly open or opened every few moments gasping for air, the intake of which causes a peculiar wheezing noise.

If the affection is localized in the upper respiratory passages it is frequently alluded to as roup. The first symptom of the disease may be a thin watery discharge from the nasal openings, which soon becomes thick (sero-mucous to muco-purulent), and of a dirty grey color. The discharge may become so thick that it will not drain out readily but accumulates in the sinuses of the head, especially those in front (infraorbital) and a little below the eyes giving them a bulging appearance. If the enlargement is pressed upon, the contents may be forced out through the nasal openings. The bird may now breathe with great difficulty, and frequently shake its head and sneeze, thereby ejecting pus and shreds of the croupous and diphtheritic membranes. It will sit around with its head drawn down, feathers ruffled, and periodically gasping for air.

When the eyes are involved they may be washed out with a warm 4 per cent boracic acid solution in water. Or you may

drop a few drops of a 5 per cent cargentos or argyrol solution in water in the eyes two or three times daily, with a medicine dropper. An uncomplicated case of chicken pox will usually last from three to five weeks.

MIXED FORM

What is known as a mixed form of the disease includes two or more of the forms described, and it usually ends fatally.

A chicken pox vaccine is prepared by some of the manufacturers of biologics for the purpose of immunizing birds against the disease.

The premises should be frequently and thoroughly disinfected with a 5 per cent solution of creolin, lysol, or carbolic acid, in water. All feed and watering troughs should be similarly disinfected. All seriously sick birds and those in which the eyesight is impaired should be killed and all dead birds cremated.

CHICKEN CHOLERA (FOWL CHOLERA)

Chicken or fowl cholera is prevalent in many countries and affects all classes of domestic poultry, as well as many kinds of wild birds.

The disease is caused by *Bacillus avisepticus*, which may be found in the blood and tissues of sick birds, as well as in all the discharges.

It may be conveyed to healthy birds through contaminated food or water. The disease may also be produced from eating the uncooked flesh of birds affected with the disease. Wild birds such as sparrows, and also pigeons, as well as people may carry the infection from sick birds or infected premises from long distances to non-infected localities.

The period of incubation varies anywhere from one to two days for water fowl and 4 to 10 days for chickens.

The disease may be acute or chronic. In the acute form of fowl cholera the bird may die suddenly or within a few hours after being attacked. Quite frequently a bird may be found dead in the morning under the roost. Birds that do not die so quickly may be found in some isolated and quiet place in a semi-standing attitude, with their feathers ruffled up and trembling. If a bird is disturbed it may run away, but for a short distance only, with its wings partly drooping, and it soon assumes its former attitude. It may turn its head backwards or hide it under a wing. A thick fluid may drip from its mouth

or nasal openings. After the disease becomes well established a profuse diarrhea sets in which later becomes very fluid and has a very offensive odor.

The symptoms of the chronic form of chicken cholera are simply those of the acute form, but greatly modified as to severity.

The prognosis in fowl cholera (also known as *Pasteurellosis avium*) is very unfavorable. The mortality may be as high as 90 per cent in a flock of infected chickens.

The sick birds should be killed, care being taken that they do not bleed where other birds may get the blood in their feed or water, and all dead birds should be cremated. All discharges from the birds should be burned, or buried deep, and the premises thoroughly disinfected, as recommended for chicken pox. All food and water should be put where it cannot be contaminated with the infection.

Vaccination has given very satisfactory results in immunizing against fowl or chicken cholera.

Some practitioners claim that the mortality in a flock of poultry affected with fowl cholera may be considerably reduced by giving the flock compound sulphocarbolate tablets in their drinking water, as an intestinal antiseptic. The medicated water may be kept before them at all times in the proportion of about one-half grain of the drug for each bird, just enough water being used so that they will drink all of it in the morning and then they may be given a fresh mixture in the evening. Or the tablets may be used in a mash in this proportion twice daily. First make a solution out of the tablets and then mix it in the mash—just what they will eat and no more. Give it twice a day, morning and evening.

WHITE DIARRHEA (BACILLARY WHITE DIARRHEA)

It is not known to what extent this disease exists in the Islands, but there is reason to suspect that it is prevalent, as well as a disease having similar clinical symptoms known as coccidiosis.

The bacillary form of a diarrhea is caused by *Bacterium pullorin* which is present in the blood and internal organs, including the ovaries of infected hens. Chicks hatched from the eggs of these hens may be infested at the time of hatching, and the disease develops shortly after they are hatched. The mortality in young chicks from either form of diarrhea is very high, but can be greatly reduced if the young chicks are not

fed anything for the first two to three days, and then given sour, or clabbered, milk only for four or five days. Young turkeys as well as chicks have a sufficient amount of yolk in their abdominal cavities to supply them with all nourishment needed for two to three days. The reason why so many young turkeys and chickens die shortly after hatching is because of indiscretion in feeding them too soon after hatching and permitting them to get wet.

To make sour, or clabbered, milk fresh or evaporated canned milk may be used. The amount necessary will depend upon the number of chicks to be fed. To the fresh or evaporated milk add a lactic acid, or buttermilk, tablet, which may be purchased from various sources. Use one tablet for the day's milk supply and let the milk stand for 24 hours, when it will have soured. For the next day's feeding add one teaspoonful of the sour milk to the next day's supply, and then a buttermilk tablet will not be necessary. To make clabbered milk let it stand longer after it has soured.

The premises in the meantime should be kept strictly clean, and frequently disinfected as suggested for chicken cholera.

There is an intradermal testing agent prepared for bacillary white diarrhea carriers in adult hens known as pullorin which is alleged by the manufacturers to have merits in determining which hens in a flock are laying eggs that hatch sick chicks. The pullorin is injected into one wattle of the hens, with the result that this wattle becomes greatly swollen in the hens which are carriers of the infection, while the opposite wattle is not swollen—this being known as a positive reaction. Such hens should then be eliminated from the flock.

If this test has merits it would greatly aid in eliminating such a serious disease from the premises and thereby save many young chicks.

TUBERCULOSIS IN FOWLS

This is known to exist in chickens in the Philippines, but the infection is not believed to be so extensive as it is in some countries.

The disease is caused by *Bacillus tuberculosis avian* and is shorter than the organism that causes tuberculosis in mammals. The chief entrance of the infection is through the alimentary canal with contaminated food or water.

The tubercles are most frequently found in the liver and spleen. The intestines are less frequently involved. The tubercles may

vary in size from that of a pin-head to that of a marble with a wall around them (encapsulated). The larger ones may contain a yellowish cheesy-like material, or the nodules may undergo calcification. The lungs are not often infected. If the infection is quite general with small (miliary) tubercles it is sometimes termed "Pearly disease."

The ante-mortem symptoms in birds, as in some other domestic animals, may not be very apparent. Sometimes there is paleness about the head with cachexia and emaciation followed by the death of the bird.

The ante-mortem diagnosis of tuberculosis is best made by administering the tuberculin (avian strain) test, which should be given by a qualified veterinarian. If there is a positive reaction the bird should be destroyed and cremated, and all the other birds in the flock subjected to the test every six months, and culled out and destroyed if they react, until the flock is clean, and then give the test once a year to keep them clean.

The organism that causes tuberculosis in fowls, as well as the one in mammals, is dangerous to man, and for this reason all birds should be cremated and the premises well disinfected from time to time with any of the disinfectants that have been suggested. Sunlight is very destructive to *Bacillus tuberculosis.*

APOPLECTIFORM SEPTICEMIA

Is known to affect chickens in the Philippines, but no deaths have been reported in pigeons or geese, both of which are very susceptible to the disease.

The disease is due to *Streptococcus gallinarium* which is found in the blood stream and the various internal organs of a bird that has died of the affection. It runs a very acute course, and death usually results within 24 hours after the first symptoms are noticed. Not many birds in a flock are affected at the same time. As a rule death takes place so quickly that post-mortem changes are not well established, with the possible exception of small pin-point hemorrhages in the liver and spleen.

The treatment consists in cremating all dead birds promptly and a general cleaning and disinfection of the premises.

Vaccination as a prophylactic has given very satisfactory results.

GAPES (*Syngamus trachealis*)

Gape worm infestation in young chickens is very common at certain times of the year in the Philippines and is the cause of the death of many young chickens.

The disease is caused by a worm (*Syngamus trachealis*) varying from one-fourth to one inch in length that attaches itself to the mucous membranes of the respiratory tract, especially to the upper portion of the trachea (windpipe). The female is from two to three times longer than the male.

The chicks swallow the small immature worms which upon reaching the intestines migrate to the respiratory organs, especially to the upper portion of the windpipe, where they attach themselves and spend the rest of their normal lives. However, the worms may be found in the bronchial tubes in the lungs.

The embryonic worm may be taken up by the chick in eating earthworms, which are frequently full of them, or the chick may take up the eggs of the worm in its food or water.

After a chick has become infested with the worm, and the worm becomes large, the chick has much difficulty in breathing. It will stand around and periodically raise its head and with the beak open gasp for air. The irritation from the worm in the throat causes the chick to shake its head and cough. If a chick dies and the upper part of the windpipe is opened up to, and including, the throat, the worm may be seen.

Some people become sufficiently skilled, with a little practice, to remove or dislodge the worm in the throat with a loop of horse hair, or by swabbing with the end of a feather that has been dipped in oil of turpentine. But there may be more of the worms in the respiratory tract that are out of reach.

In the beginning of the rainy season when the earthworms come to the surface of the ground the infestation in young chicks is the heaviest.

If young chicks are kept from the time they are hatched on board floors that are frequently disinfected, and not permitted to run in the open there would be little chance of their infestation with the embryonic form of the parasite.

LICE OF BIRDS

Kaupp—Poultry Diseases—says that there are more than 30 species of external parasites that infest birds, which may be divided into seven different classes. Their economic importance is very great since, if the infestation is sufficiently heavy they will prevent the normal productivity of eggs and gain in flesh. In young chicks they will stunt their growth, and frequently cause death.

Lice, of all varieties, are readily transferred from infested to non-infested birds, through actual contact or through infested premises.

They may all be grouped and dealt with as one, so far as our purpose is concerned.

The Maine Agricultural Experiment Station recommends very highly an insect powder formulated by Mr. R. C. Lawry, formerly of the Poultry Department of Cornell University, which is as follows:

	cu. cm.
Crude carbolic acid, 90 to 95 per cent strength	500
Gasoline	1,500

Mix these together and add gradually, all the time stirring, just enough of plaster of paris (a powder) to take up all the *moisture, and no more.*

When enough plaster of paris has been added the resulting mixture should be a dry, pinkish-brown powder having a fairly strong carbolic acid odor and a rather less pronounced gasoline odor.

This powder is to be worked into the feathers of the birds affected with vermin, particularly into the fluff around the vent and on the lower side of the body and in the fluff under the wings. It is said to be a very effective insecticide for all kinds of bird lice, fleas, and chiggers, and it is also very cheap.

If the crude carbolic acid in 90 to 95 per cent strength is not available cresol in the same amount may be substituted and used in the same way.

As a general rule it will take about four kilos of the plaster of paris to one liter of the liquid.

A small insect powder-blower, which may be obtained in any drug store, is convenient for applying the powder to the birds efficiently and without undue loss of the insect powder through wastage.

The powder should be kept in a tightly covered can to prevent, as far as possible, the evaporation of its constituent medicaments. Or powdered sodium fluoride which is cheap and available in nearly any drug store, may be used in the same way. It is also well to keep a few moth balls in the nests, and in holes bored in the roosts.

In using any kind of louse powder on poultry, it should always be remembered that one application is not sufficient. When there are lice present on a bird there are always unhatched eggs of lice (nits) that are attached to the feathers and within four days to a week they will hatch out, as the powder does not destroy the eggs.

After the eggs are hatched, in from four days to one week, another application of the powder should be made and, better still, a third application after a lapse of four days to one week. The powder should be dusted in the nests from time to time.

It is believed that lice are the greatest enemy to the pigeon industry in the Islands. The same kind of treatment is applicable to pigeons, or to any other kind of birds.

Clean up the premises thoroughly, including the pigeon cotes, and empty all old nests, and then spray the roosts, walls, floors, nest-boxes, etc., thoroughly with petroleum (kerosene) and, preferably, repeat in one week. All lice and bedbugs are quickly destroyed by petroleum, which is cheap and available in every barrio and sitio in the Islands. However, to be effective the petroleum must be reapplied in about one week and, preferably, a third application in another week. Lice and bedbugs are undesirable tenants from any point of view, and should be exterminated. Indeed bedbugs have been accused of transmitting leprosy and syphilis, and it has never been proved that they may not do so.

SCALY LEGS (MANGY LEGS, SCABIES)

This disease is very common in chickens in the Philippines and is communicable from one bird to another. It is caused by scab mites (*Sarcoptes mutans*) that attack the lower part of the legs and the feet of birds, thickening the parts and forming scales.

The successful treatment of scaly legs is slow and tedious and must be very thorough. As it is very doubtful if any birds in the Philippines are valuable enough to justify treatment, it is advisable to kill all infested birds promptly and eat them, except the feet and legs, which should be burned; for a person with a flock of good birds can not afford to take chances by keeping a bird with scaly legs (scabies) among them.

The premises, particularly the roosts, should be thoroughly disinfected from time to time with petroleum.

FOWL TYPHOID (INFECTIOUS LEUKEMIA)

This disease in chickens should not be confused with typhoid fever in man, as there is no relation whatever between them. So far as known fowl typhoid has never been reported in the Philippines.

The disease is caused by *Bacillus sanguinarium*, which organism may be found in the blood of infected birds. The period

of incubation is said to vary from 30 to 60 days, and the course of the disease after it has once developed is from four to five days to several months. The mortality of those affected is said to be about 100 per cent.

The clinical symptoms are paleness about the head, progressive weakness, and extreme prostration near the end.

A positive diagnosis may be made, ante-mortem, by a blood count. The red cells are found to be greatly decreased in number while certain white cells are greatly increased in number. The disease is communicable and incurable, and for this reason all birds known to be sick with the disease should be killed and cremated, and there should be a general cleaning-up and disinfection of the premises.

BLACKHEAD (ENTERO HEPATITIS)

The disease has been reported in turkeys in the Philippines, but has never been found in chickens, although they are susceptible to it, but not to the same extent as turkeys.

The first symptoms noticeable will be a tendency of the sick birds to mope and sit around, with the feathers ruffled, wings drooped and loss of appetite. There is rapid emaciation, and a diarrhea frequently followed by death in from 3 to 10 days; or the disease may pass into a chronic form. The recognized authorities are of the opinion that the disease is due to a protozoön known as *Amœba meleagridis* found in the ulcerated areas in the cæcum and liver of affected birds, which are chiefly turkeys, and more rarely chickens.

The treatment consists of a very thorough cleaning-up and disinfection of the premises. Considerable success is claimed from administering compound sulpho-carbolate tablets in drinking water, giving no water not thus medicated; or wine of ipecac—about 10 drops for an adult bird and less for smaller birds. Or the latter may be given in a wet mash in the same proportion.

The reason the disease is called blackhead is because the head sometimes turns black, but not in all cases, just before death.

AVIAN PEST

The following is a brief summary, in part, of a radio lecture on the Avian Pest in the Philippines, by Dr. Estefano C. Farinas of the Veterinary Research Laboratory, Bureau of Agriculture.

A very destructive disease of chickens appeared in the City of Manila during September, 1927. In a very short time thereafter the disease was found in Malabon to the north of Manila

and as far as Los Baños to the south. The total loss of chickens to date is estimated to be about 70,000.

The disease is not similar to any before reported except one reported by Doyle, Veterinary Laboratory, English Ministry of Agriculture, as occurring in 1926 on a farm in Newcastle-on-Tyne, which he called the "Newcastle Disease." However, there is no positive proof that the disease occurring in the Philippines and that reported in England are one and the same disease. The one in the Philippines has been termed the "Avian Pest."

The disease is very contagious and fatal to chickens, ducks, turkeys, guinea fowls, pigeons, and wild birds.

There is an irregular temperature, loss of appetite, and diarrhea. There may be a gasping for air, a copious mucous discharge from the beak and nostrils, rapid emaciation and death within about seven days, in the usual form of the disease. In the more prolonged cases there is a modification of these symptoms, even to no gasping for air, which may end in death or recovery after a long illness, or by the appearance of a nervous derangement such as paralysis of one or both legs, muscular spasms, unsteadiness of the head and gait, and twisting of the neck. These symptoms may persist for several weeks or even permanently; and, depending upon the severity, the animal will either ultimately die or recover.

The post-mortem symptoms are: (1) glary, tenacious mucus in the nostrils, paranasal passages, and mouth cavity; (2) congestion or hemorrhage of the serous wall of the œsophagus and crop; (3) diffused inflammation of the duodenum and cloaca; (4) blood blotches of various sizes and shapes on the gizzard muscle, proventriculus, cæca, and rectum. The ileo-cecal valve is commonly the seat of severe hemorrhage; (5) small blotches on the heart muscle and gizzard fat are seen in some cases; (6) gelatinous infiltration under the skin at the crop region is observed in fat animals with acute attack.

The fatal malady is caused by a very minute organism which passes through filters that hold back visible virus. The secretions from the mouth are very infectious even in small quantities. The feces of a sick bird are apparently not dangerous. Infection may be carried from locality to locality by wild birds, for instance sparrows, or by sick birds drinking from a poultry water container. Cohabitation of a sick bird with a well bird will also produce the disease in the well bird, and this may infect other birds before it comes down seriously sick with the disease.

There is no cure for Avian Pest after it has once developed; the only hope at present lies in prevention.

There should be a general cleaning-up and disinfection of the premises, including the drinking containers, which should frequently be disinfected. Withhold all water except that which is medicated with permanganate of potassium in the strength of 1:5000, and change this for a fresh supply twice daily. The strength can readily be obtained after the size of the tablet is known, or the druggist will assist in determining it.

The least number of possible carriers (as people, etc.) from other places that come on the premises the better, as they may carry the disease on their feet or clothing.

Promptly kill and cremate all sick birds. Sprinkle slacked lime around on the chicken runs.

LIMBER NECK (PTOMAIN POISONING, BOTULINUS)

Is the result of eating decomposing food like meats, and particularly fish, or of canned vegetable foods that may have been left to spoil and then thrown out. It also occurs as a result of eating blow-flies or maggots, which are invariably found in and around certain decomposing material, which may not always be meat.

The disease derives its name "limber neck" from the fact that the bird can not hold its head up due to the limp condition of the neck. The disease appears quite suddenly and may affect one or more birds simultaneously, depending upon the number that have eaten the spoilt food and the amount that they have eaten.

The treatment is to remove the cause, by removing all decomposing food, etc. Give the affected birds Epsom salts—a teaspoonful dissolved in a little water, or a tablespoonful of castor oil. This may be followed with one-eighth to one-fourth grain of strychnin sulphate tablet in the morning, at noon, and at night.

The disease is not communicable from a sick to a well bird directly.

ROUND WORMS (ASCARIDS)

These worms are very common in all classes of animals. In dressing a chicken if the intestines are opened they may be readily seen if present and frequently in the stools of an infested bird.

Give an adult chicken one globule containing from 15 to 20 drops of carbon tetrachloride. Or powder a ripe areca nut and

give an adult chicken about two-thirds of a gram in a small amount of wet mash of tiqui-tiqui, after having first put the fowl into a coop without any feed for about 18 hours. Or give tobacco stems that have been chopped up fine and steeped in water for two or three hours. Kaupp—Poultry Diseases—recommends this in the proportion of about 250 grams in a wet mash to 50 fowls, that have been kept fasting for about 18 hours. Or give an adult fowl from one-eighth to one-fourth grain of santonin, after having first kept it fasting for about 18 hours.

Whatever treatment is used should be repeated in three or four days to kill the worms that are subsequently hatched from the eggs left in the intestinal tract.

Birds that are undergoing treatment should be kept up in a coop with a slat floor in order that the droppings can pass through and after thorough disinfection removed and buried deep, to prevent them from being scattered around over an extensive area to be picked up by other birds.

In the meantime thoroughly clean up and disinfect the premises.

BUMBLE FOOT (STONE BRUISE)

Is very frequently seen in chickens, especially those of the heavier type that roost high up: It consists of an abscess in the bottom of the foot most frequently caused by a bruise of the parts when flying down from high roosts.

The bird is more or less lame in the affected foot, and the enlargement can readily be seen.

To treat the bird hold its foot for a few minutes in a 5 per cent solution of creolin in water, and with a sharp knife that has been immersed in the creolin solution, after having first washed the hands in the same solution, make a free incision towards the toes and let the thick pus out and then cauterize the abscess cavity with pure carbolic acid or with silver nitrate. Then place the bird in a coop that has the bottom well covered with clean rice straw, and wash the abscess cavity out once daily with a solution of creolin in water, until the incision in the foot closes. Bumble foot in birds may be prevented, in a large measure, by lowering the roosts.

EGG-BOUND

This condition signifies that the egg can not be passed through the regular channels and may be due to several causes, one being a broken egg which has obstructed the channel. The first symptoms noticeable are that the hen will frequently go to the nest to

lay, possibly several times in one day, but no egg is deposited. In course of time the abdomen becomes large and sags, possibly to such an extent as to interfere with the bird walking.

The best treatment is the bolo route to the table.

OVARIAN CYSTS

These are occasionally seen in young pullets and adult hens in the Philippines. The abdomen may become so large that the bird must walk in an upright position, like a penguin. The cyst, or bladder, may contain a large amount of fluid and the weight of the contents of the cyst causes the peculiar attitude in walking.

The best treatment is the bolo route to the table, the same as for hens which are egg-bound.

CROP BOUND (IMPACTION OF THE CROP)

This is not very often seen in chickens, although it occasionally occurs from eating something that is indigestible or that can not be macerated in the crop.

About the only treatment that may be successful is to make an incision into the crop, under cleanly conditions, and remove the contents that are causing the trouble. The operation is a very simple one; there is no blood. After the removal of the mass take a suture or two in the crop, and do not draw them too tight so that they will entirely obstruct the blood supply to the tissues enclosed in the suture bites.

COLDS (CATARRH OF THE UPPER RESPIRATORY PASSAGES)

The causes may be the same as for colds in other animals, such as sudden changes in the weather, roosting in draughts, and getting wet from cold rains, etc. There is at first a watery discharge from the nasal openings, which later becomes thicker. There may be sneezing and more or less lassitude. The symptoms resemble a mild form of roup, sometimes termed the nasal form of diphtheria, but the peculiar odor of roup is absent.

Ordinarily fowls recover from uncomplicated colds of their own accord if the causes are not continued, such as roosting in draughts, cold rain, etc.

PIP

Is a term that indicates some abnormal condition in which the end of the tongue becomes dry and more or less hardened. It is not a disease in itself, but is a symptom or a consequence of some other affection. The treatment is that for the cause, which is always some other disease.

PERCENTAGES IN SOLUTION

One gram, if a solid drug, in 100 c. c. of water, makes a 1 per cent solution.
Five grams, if a solid drug, in 100 c. c. of water, makes a 5 per cent solution.
Ten grams, if a solid drug, in 100 c. c. of water, makes a 10 per cent solution.
One cubic centimeter, if a liquid drug, in 99 c. c. of water, makes a 1 per cent solution.
Five cubic centimeters, if a liquid drug, in 95 c. c. of water, makes a 5 per cent solution.
Ten cubic centimeters, if a liquid drug, in 90 c. c. of water, makes a 10 per cent solution.

IN CONCLUSION

What is believed to be the most successful poultryman in the Islands today started a few years ago with practically nothing, like the party in the foregoing pages. He has gradually built up the business through personal attention to details and, from a mere side issue at first, he has it now on a substantial paying basis. He sets the eggs from specially selected hens, mated to the very best rooster of the particular breed that he can possibly obtain, either through importation or otherwise. Whenever he got a few pesos ahead he put them back into the business, and then it is a case of the old story over again, that: "Large oaks from little acorns grow." He even imports the feed for the chickens, which he says sometimes costs a little more and sometimes a little less than substitute feeds would cost him locally. Nevertheless, he says that it pays, not only in the quantity and quality of egg-production, but also in the physical condition of his chickens. He gets a very special price, from very exacting customers, for very special eggs, and can sell all of them that he can possibly produce.

In order to obtain such special advantages, he realizes that he must have very special egg-producing bird machines to begin with, and the best feed (fuel) that it is possible to obtain to feed the egg-producing machines in order to get the maximum quantity and quality in egg-production.

It is not to be understood, however, that for a person to make a success in poultry raising it is necessary to import feed for the birds, for such a procedure would be impractical and unnecessary for most people.

There is both profit and pleasure for many people in raising poultry, and any generally worthwhile success usually starts from the very bottom and develops step by step.

GRAZING GRASS

Several years ago an African grass known as "Kikuyu" was introduced into certain sections of the United States as well as Australia. The livestockmen of these countries made very favorable reports on the merits of the grass for grazing purposes. The attention of the Bureau of Agriculture was invited to these reports as to the feasibility of introducing the grass into the Philippines. As a result, a start of the grass was brought in by the Bureau and planted in several localities in the Mountain Province, where it is now thriving. It is not known yet whether or not it will thrive in the lowlands, although it is said to be very resistant to drought and, in addition, it has every indication of holding its own with the grasses that are indigenous to the country.

It is believed that this grass is worthy of a trial in the lowlands and cuttings will be furnished, free of charge, by the Bureau of Agriculture, to a limited number of people who may wish to give it a trial. Incidentally, it makes a very attractive lawn grass, similar to the coarse Bermuda but not so coarse as the Dallis grass which is used very extensively for lawn purposes.

Should this grass prove to be satisfactory for grazing purposes (as there is every reason to believe that it will), it would be very beneficial to the livestock industry in the Philippines. It would not only be very valuable for Philippine cattle but it would be particularly so for the improved breeds, like high quality beef and dairy cattle. It is a well-known fact that the quality and quantity of the feed influences very largely the quality and quantity of the meat as well as that of the milk. If the grass will subsist the improved breeds of herbivorous animals in the United States and in Australia, it is believed that it will do the same for similar animals in the Philippines, provided the mineral elements in the soil are very similar.

An abundance of suitable feed is absolutely necessary at all times in raising any class of animals in order to get the maximum results.

In passing, it may be stated that in nearly any authoritative work on stock breeding or on feeds and feeding, the German adage, "The eye of the master fattens his cattle," is quoted. This old adage which has long been known by a few, is now proved a well-established fact, and is becoming more generally recognized as the fundamental principle of success in the raising of every kind of animal.

There is much satisfaction and personal distinction in owning the very best animals in your locality, no matter whether they are carabaos or chickens or any other kind of animals, and in knowing that they will compare favorably with the best animals of their kind in any other locality. But this in itself is not satisfying enough, as the animals in any locality may not be as good as they should be.

A successful livestock breeder, or fancier, should have very high ideals as a standard and then measure up to them in actual practice. This can be done by persisting in the determination that, through careful selection of breeding animals, each succeeding generation of the kind that he is raising shall be better, and better, and better. And this can best be accomplished by following closely the general principles of livestock breeding and care advocated throughout this article.

ACKNOWLEDGMENTS

In the preparation of the foregoing pages all possible facilities were afforded to help the work, and much indispensable advice was given, by Dr. Vicente Ferriols, Chief of the Animal Industry Division, Bureau of Agriculture, all of which the writer acknowledges with grateful appreciation.

To Mr. Alfonso Tuason, Chief of the Animal Husbandry Section, and to Mr. Carlos X. Burgos, Jr., Mr. Jose Guevara, and Mr. Exequiel Alcasid, all animal husbandmen, Bureau of Agriculture, the writer is indebted also not only for valuable suggestions but for their having made available for this purpose the many splendid animals of various kinds raised under their direct supervision that are shown in a number of the plates.

The introduction and propagation of Kikuyu grass in the Philippine Islands is due very largely to the work of Mr. P. J. Wester, a horticulturist in the Bureau of Agriculture.

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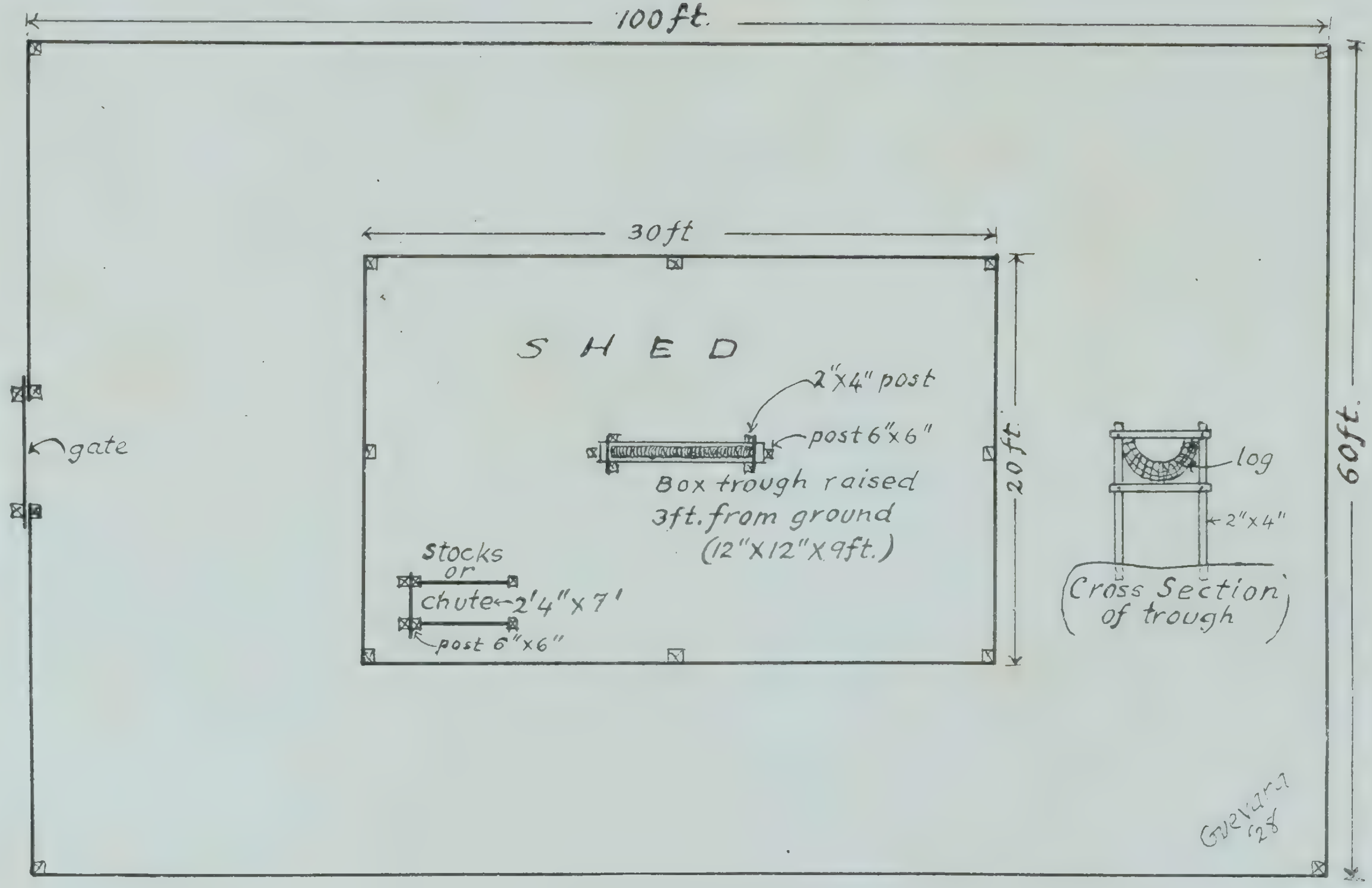
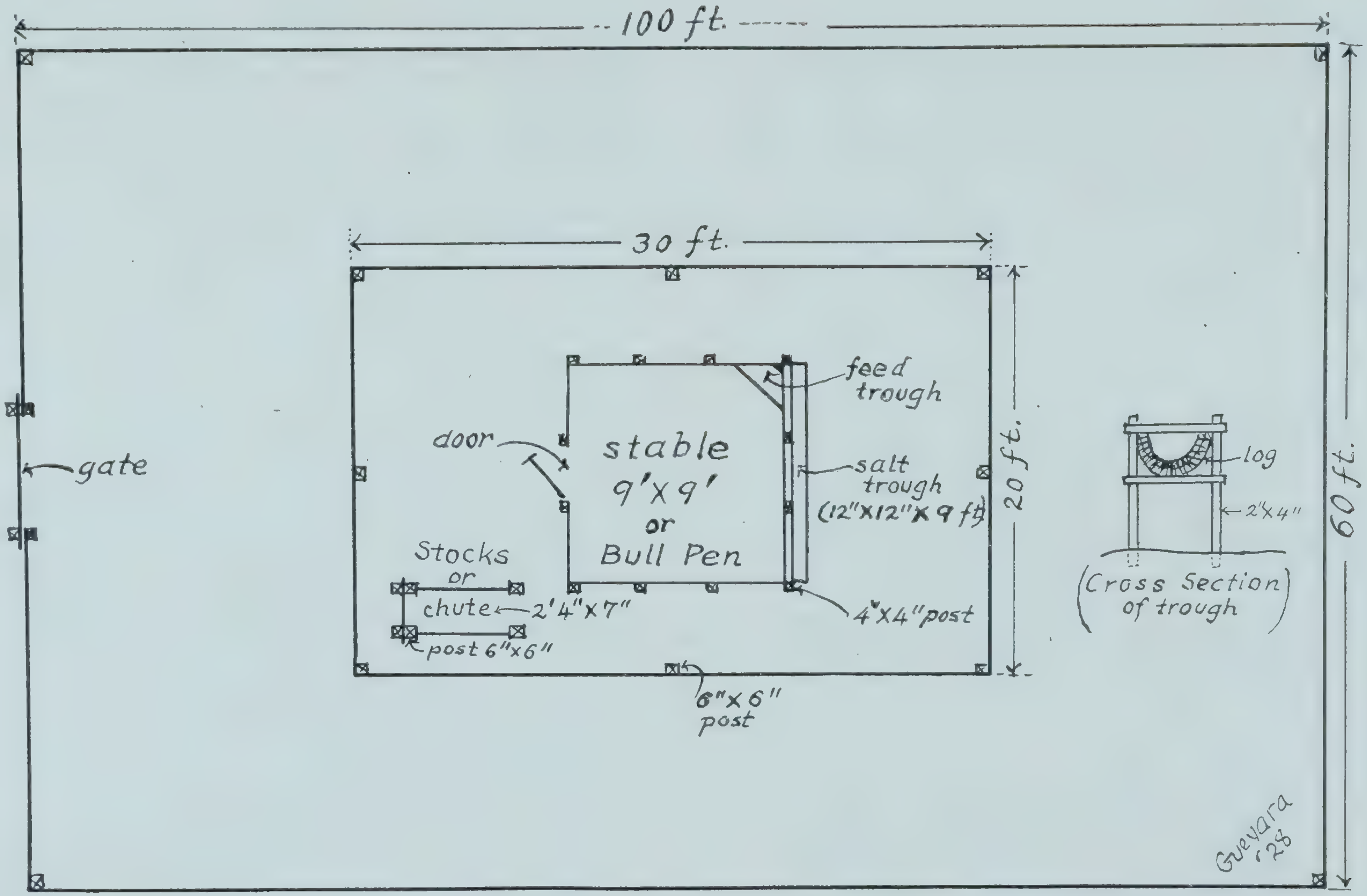


Ranch Plan (Shed) No. 1

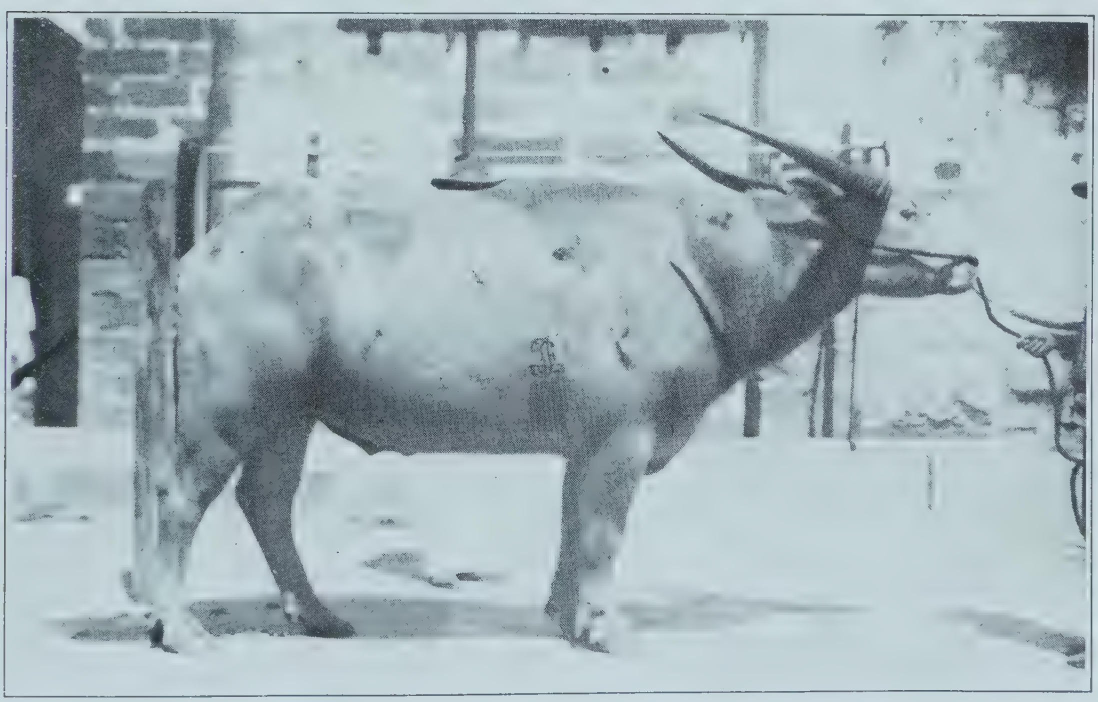


Ranch Plan (Shed) No. 2

(*a*) Ilocano type of work bullock

(*b*) Batangas type of bull

(*a*) A Philippine type of carabao



(*b*) A Cambodian type of carabao

(a) A fine type of Indian (Nellore) cow

(b) A fine type of Indian (Nellore) bull

A small herd of young Indian (Nellore) cattle, born and raised in the Philippines

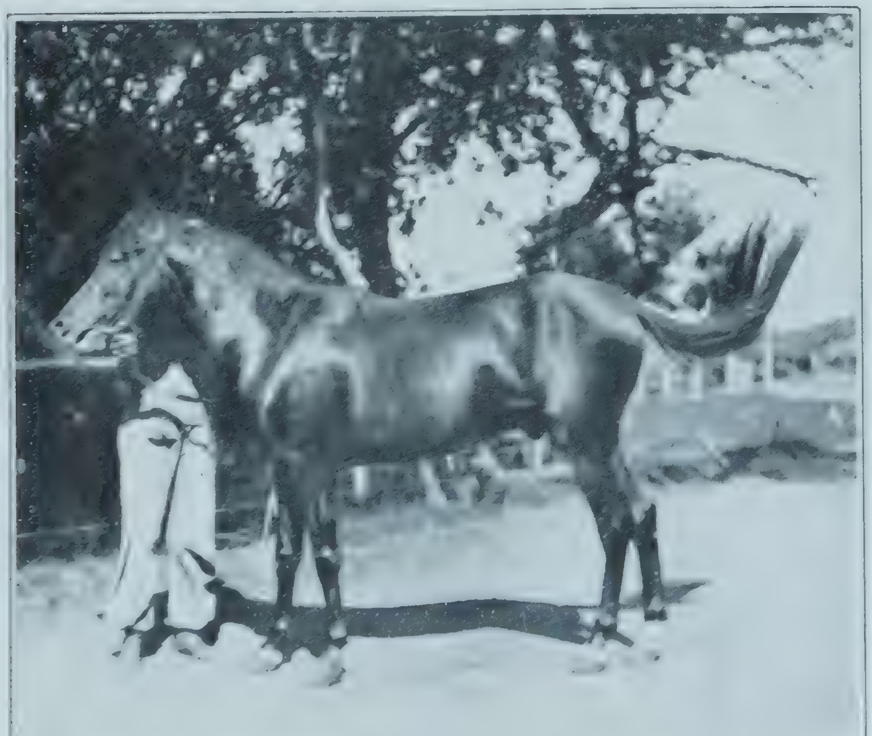
(*a*) Scrub cattle sired by grade Indian bulls. Two mothers were grade Indian cows; two, Philippine cows

(*b*) Degenerated, or scrub, carabaos with which the country is overstocked. Their greatest value lies in what can be realized on them for meat

(*a*) A fine type of Philippine pony

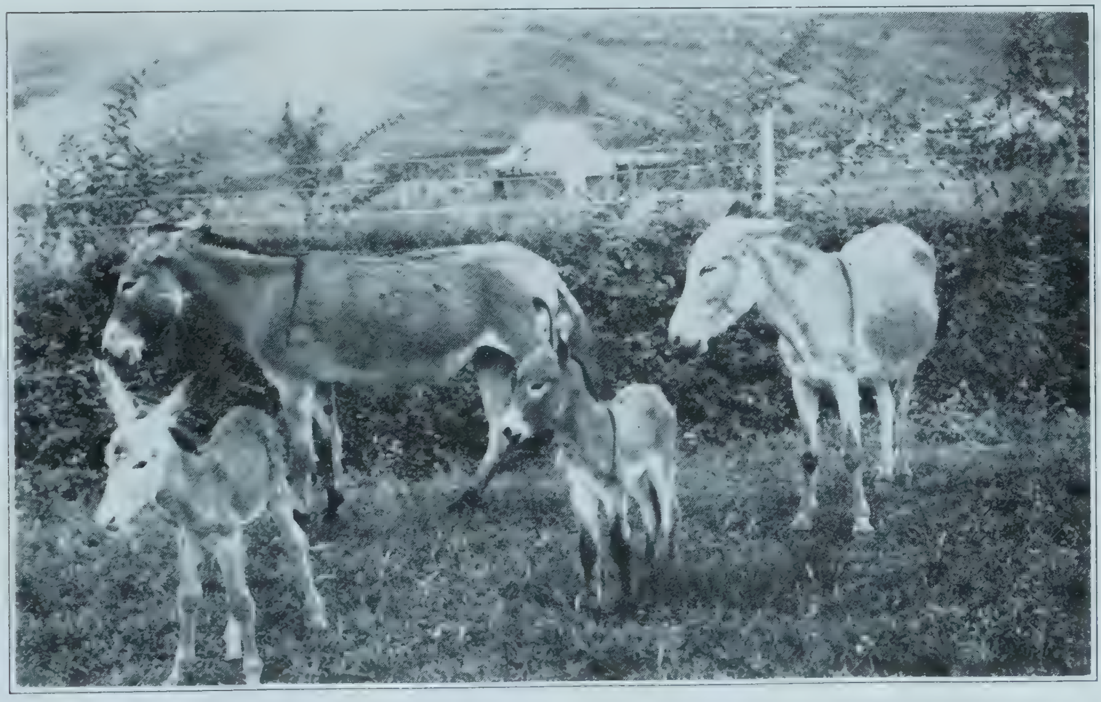
(*b*) Another fine type of Philippine pony. The otherwise good appearance of Philippine ponies is usually and greatly marred by their having their tails bobbed

(a) An imported Arab stallion



(b) A cross between an Arab stallion and a Philippine mare

(*a*) An imported burro jack from Arizona



(*b*) Imported burro mares from Arizona, with burro colts born in the Philippines

(*a*) Philippine mares with burro mule colts

(*b*) A fine type of small mule, adult burro-Philippine, for riding in the mountainous regions. This animal, however, plainly shows the lack of proper feed and care

(*a*) A Sussex bull imported from Australia—an improved beef breed type of animal

(*b*) A Devon bull imported from Australia—an improved beef breed type of animal

Young Aberdeen-Angus bulls of the highly improved beef breed type of animals, recently imported from Australia and immunized to rinderpest

(*a*) An Ayrshire bull

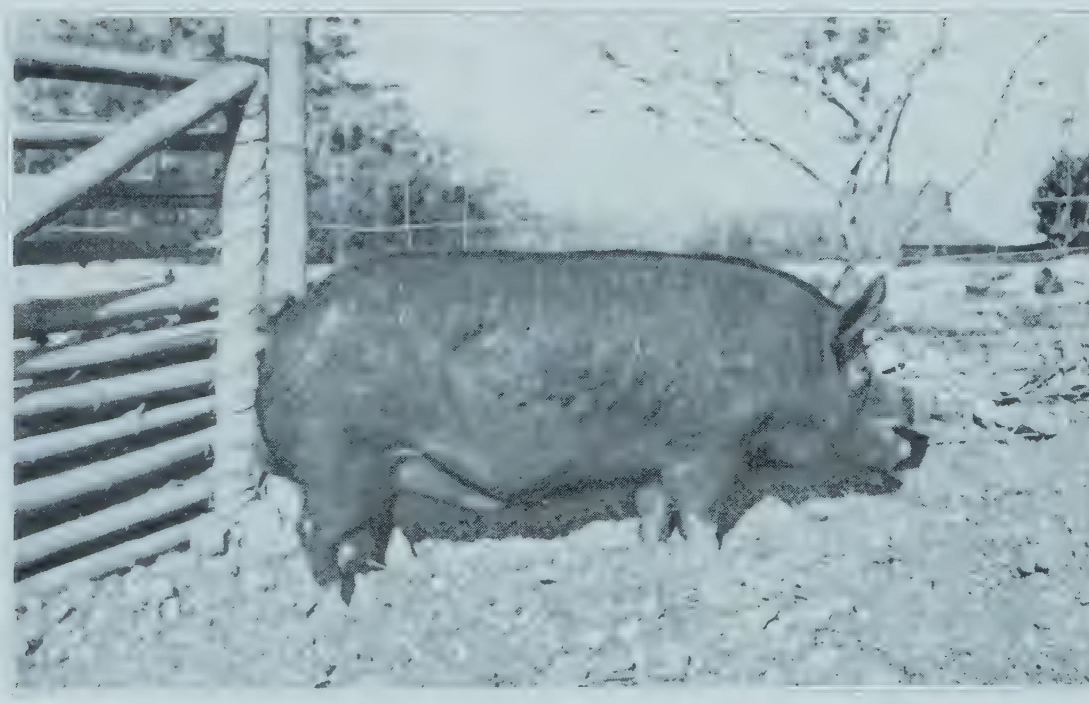
(*b*) Young Ayrshire cows recently imported from Australia and immunized to rinderpest. The Ayrshire cattle are one of the highly improved milking breeds

Pure-bred Shropshire sheep thrive in the Mountain Province. Their mutton is of good quality and the annual wool clip per head will vary from two to three kilos

(*a*) A milking type of Indian goat

(*b*) An Indian billy-goat

Anglo-Nubians, a milking breed of goats recently imported from the United States. The four kids—you must look carefully to find them—were born in the Philippines and show every indication of thriving



(*a*) A fine type of Berkshire boar

(*b*) A Berkshire sow and pigs

(*a*) Berkshire hogs about nine months of age

(*b*) Cross-breds between a Berkshire boar and Philippine sows, about two years of age

(*a*) A fine type of Yorkshire boar

(*b*) Young Yorkshire sows

(*a*) A fine type of single-comb White Leghorn rooster

(*b*) A fine type of single-comb White Leghorn hen. The Leghorn breed of chickens may be either white, brown, or buff in color, and all of them are noted for the large number of large white-shelled eggs that they lay. They are non-sitters

(*a*) A fine type of Rhode Island Red rooster

(*b*) A fine type of Rhode Island Red hen. The Rhode Island Red chickens are prolific layers and good table birds, thereby serving a dual purpose

(*a*) A fine type of Barred Plymouth Rock rooster

(*b*) A fine type of Barred Plymouth Rock hen. The Plymouth Rock breed of chickens are all-round general purpose birds—good layers, good sitters, and good table birds

A pen of White Leghorn chickens. The Leghorn breed of chickens average high in egg-production

A pen of Buff Orpingtons, all-round general purpose chickens and very popular with many people in the southern islands

A pen of Barred Plymouth Rocks. They are very popular all-round general purpose chickens

A pen of light Brahmas, one of the largest all-round general purpose breed of chickens

PLATE XXXV

A flock of Indian Runner ducks. They are noted for the large number of eggs that they lay, and for their fine flavor as table birds. They are non-sitters

A flock of Toulouse geese raised in the Philippines. All breeds of geese will live on grass if it is green and short, but they should be fed liberally for a month or two before marketing

Turkeys can be raised in the Philippines, but require close attention during the first few months after hatching

Six hundred and twenty-six animals receiving a new lease on life as a result of being vaccinated with anti-rinderpest vaccine

Homeward bound after having been vaccinated with anti-rinderpest vaccine

Evening time in the highlands of Northern Luzon

NOTES—THIRD QUARTER

OUR NEW SECRETARY

"A farmer statesman, tried and tested worthy"—that in a nutshell describes the man who now heads the Department of Agriculture and Natural Resources for he had a humble start, scaled the ladder from the lowest rung to the top. At first a mere "collector," an errand boy, so to speak, he began his career as a public servant. Later he became a factor in provincial politics, and developed into a tactician of the first order in the Legislature. Versatile, ever resourceful, possessing a generous reserve of energy and talent, he has always had a way of adapting and applying himself to the task put upon him and doing it as few other men could.

Versed in the complicated art of politics, he was easily the floor leader of the House of Representatives. Retiring from the forum to the farm, he organized and built up one of the most modern sugar centrals in Occidental Negros, the leading sugar producer in the Islands. In recognition of this efficiency, he was made president of the Philippine Sugar Association, the most effective agency for the promotion of scientific agriculture on a large scale. From the farm he has come back to the city, leaving behind his remunerative personal interests, and has chosen to accept the position of Secretary of Agriculture and Natural Resources. He is one of the few in the Islands today qualified by temperament, training and experience to fill the position, and the Governor-General made a happy choice when he appointed him to render a few years of his invaluable services to the cause of agriculture and allied industries, which form the backbone of the economic life of the Islands.

THE EIGHTH AGRICULTURAL CONGRESS

Some two hundred farmers from the different regions of the Islands, representing diverse agricultural industries for the eighth time convened in Manila from September 11 to 15 to deliberate on questions affecting Philippine agriculture. Speeches by Secretary Rafael R. Alunan of the Department of Agriculture and Natural Resources, President Manuel L. Quezon of the Philippine Senate, Acting Director of Agriculture Jose S.

Camus, Mr. Ruperto Montinola, President of the Congress, President Rafael Corpus of the National Bank, and others were delivered during the course of the congress. The Agricultural Congress passed resolutions requesting the following changes:

That the Governor-General appoint a Filipino as a permanent general manager of the Philippine National Bank.

That the Philippine National Bank be converted into an agricultural bank.

That no change be made in the present land laws.

Protesting against the adoption of the Timberlake resolution in the American Congress and measures of similar nature.

Recommending the appropriation of additional funds for the establishment and maintenance of an agricultural experiment station in every province.

Asking that the Japanese land holdings in Mindanao be investigated.

Recommending the appropriation of ₱100,000 every year for the establishment and maintenance of vocational agricultural schools in the provinces.

Requesting additional funds for a campaign under the Bureau of Labor against the independent emigration of Filipinos to foreign countries, particularly Hawaii.

Recommending the establishment of coöperative marketing associations among Filipino planters and merchants in the capital of every province.

Petitioning the American Congress and the President of the United States to revise the tariff under the present free trade arrangement between the United States and the Philippines so as to include rice in the list of free goods.

Recommending the amendment of Act No. 3155 to permit the free importation of work animals from foreign countries.

Requesting the Department of Public Instruction to give more emphasis to vocational education.

Recommending the enactment of a law creating a board of standardization and inspection of copra.

Requesting the appropriation of sufficient amount to campaign for the improvement of the quality of copra.

Petitioning the Manila Railroad Company to reduce the freight rates on agricultural products.

Recommending the appropriation of ₱100,000 every year for the improvement of the Philippine tobacco industry.

Petitioning the Legislature to increase the present tariff on imported rice by 30 per cent.

Requesting the Insular Government to transfer the Government livestock station from Bongabong, Cabanatuan, to another place.

Electing Senate President Manuel L. Quezon as honorary president of the Ninth Agricultural Congress.

Requesting a greater appropriation for the construction of more inter-municipal and inter-provincial roads.

Thanking the outgoing president of the Eighth Agricultural Congress and the members of the board of directors for the successful work of the congress.

Authorizing the president of the Agricultural Congress to appoint a committee composed of the growers from the principal rice regions to campaign for greater participation of the Filipinos in the rice trade.

Authorizing the new board of directors to establish various associations of Filipino planters under the joint auspices of the Chamber of Commerce of the Philippines and the Agricultural Congress.

The officers elected for 1929 are: Vicente T. Fernandez, *president;* Tito Silverio, *first vice-president;* Juan B. Alegre, *second vice-president;* and Mauro Prieto, Ruperto Montinola, Francisco Benitez and Manuel Urquico, *members* of the board of directors.

THE SUGAR CONVENTION

Three hundred sugar men and women representing 24 subscribing centrals and 7 planters' associations from the principal sugar-producing provinces attended the Sixth Annual Convention of the Philippine Sugar Association from September 17 to 22, 1928.

In the absence of the president who is now Secretary of Agriculture and Natural Resources, Rafael R. Alunan the second vice-president, Mr. L. Weinzheimer, presided and opened the convention on September 17 before the largest attendance ever recorded. Mayor Tomas Earnshaw of Manila welcomed the sugar men and Secretary Perez of Commerce and Communications delivered the principal address of the opening day.

All the phases of the sugar industry from planting to marketing were taken up and discussed during the convention. Among the topics deliberated upon were cane cultivation and animal husbandry, by H. Atherton Lee; cane varieties, diseases and fertilizers, by Dr. Manuel L. Roxas; agricultural machinery, irrigation and drainage, by Jose Gomez; and transportation and harvesting, by R. C. Pitcairn; manufacturing machinery, by Theo. Nickelsen; annual synopsis, by E. T. Westly; by-products and methods of chemical control, by Dr. E. M. Gross; refining quality of Philippine sugar, by H. Walker.

The conventionists were fêted by different leading social organizations as well as by large business firms. Governor-General Henry L. Stimson invited them to a luncheon at Malacañang. The Atlantic Gulf and Pacific Commercial Company, the Manila Rotary Club, the Centro Escolar de Señoritas, the Kahirup Club and the Ateneo de Manila Cadets entertained them socially. The Pacific Commercial Company gave them an excursion to the Central Azucarera de Tarlac at San Miguel where it has recently installed the most modern sugar machinery

in the Far East. The Canlubang Sugar Estate also invited them to an excursion to its sugar central and hacienda in Calamba, which used to be the largest sugar mill before the installment of the new central in Tarlac. Planters' day was celebrated at Canlubang under the auspices of the various planters' associations in the Philippines.

The convention passed the following resolutions:

That the board of trustees of the Philippine Sugar Association be given full power to appoint a committee to carry on the fight in the United States against the Timberlake resolution limiting the entry of duty-free Philippine sugar to 500,000 tons annually.

That the board of trustees be authorized to urge the Governor-General to send a Government delegate to the United States to counteract any discriminatory legislation on Philippine products, particularly sugar; if possible to persuade the Chief Executive to send Secretary Rafael R. Alunan to lead the campaign.

That the Insular Government be petitioned to permit the free importation of work animals from foreign countries until such time as the local supply is able to meet the demand of the sugar planters.

That the sugar planters be urged to coöperate with the local cattle raisers for the promotion of the local supply of work animals as well as of beef animals.

That the board of trustees be authorized to look into the feasibility of maintaining closer relations between the local sugar associtiion and the sugar promoters of Java and Formosa.

That a committee be created to work for the formation of an association of sugar technologists for the advancement of the industry in the Islands.

That the board of trustees be authorized to take up with each central the feasibility of centralizing and standardizing the buying of tractors and other farm implements through the association or that a coöperative association among sugar planters be formed to do such buying.

That the insular authorities be petitioned to give greater appropriation for the improvement of the road system in all sugar districts in the Islands, if possible for the gradual construction of first-class roads.

That the members of the association thank Secretary Rafael R. Alunan for his long, efficient services as president of the association, and that in recognition of his ability he be elected as honorary president of the association.

That Governor-General Stimson be thanked for leading the fight against the Timberlake resolution, and similarly Senate President Quezon for informing the local sugar industry of the true situation in the United States in connection with the same resolution.

That Secretary-Treasurer Geo. H. Fairchild be thanked for the efficient work for the association, similarly all other offices or entities and individual persons who had helped or coöperated in the successful holding of the convention.

Recommendations submitted to the convention for the future action of the board of trustees:

Appropriation of ₱4,000 a year for the continuation of the soil surveys of Dr. Pendleton for Luzon and analysis of soil samples for available potash or phosphoric acid and for determination of hydrogen.

Establishment of more sugar experiment stations, at least one in Luzon and another in Negros.

Urging sugar planters to extend legume rotation with sugar cane with the use of Chinese or Spanish peanuts which are found to give more beneficial results than rice.

That the Philippine Sugar Association should hasten the establishment of a well-organized experiment station, if possible to petition the insular authorities to transfer to the association "La Granja Modelo" for experiment purposes.

Renewing the former recommendation to petition the Legislature, through the Governor-General, to make appropriation to investigate the possibility of producing nitrogen from the air by hydro-electric power.

Urging sugar planters in Luzon to educate their aparceros or inquilinos along modern lines of cane culture.

That steps be taken to oppose any increase in taxes on illumination or motor oil used in the sugar industry.

Endorsing the proposed bill on recruiting labor prepared by the Bureau of Labor, requiring labor contractors or recruiters of laborers for agriculture to secure licenses and file a bond.

Urging technical men in charge of the sugar factories to give more attention to the betterment of the refining of sugar, utilizing the experience gained by other countries and providing additional boiling house equipment in cases where this is found necessary.

Urging every sugar planter to continue to experiment on better cane varieties and to resort, if possible, to a mechanical process of cultivation in order to increase the yields of cane per hectare.

Appointing additional entomologists to extend the experimental and control work on cane diseases and pests.

The new officers of the association elected at the close of the convention are:

President, Wenceslao Trinidad
First Vice-President, J. M. Elizalde
Second Vice-President, L. Weinzheimer
Third Vice-President, Damian de Urmeneta
Fourth Vice-President, Jose Gomez
Secretary-Treasurer, Geo. H. Fairchild

Secretary Alunan was elected by acclamation honorary president of the association.

FROM OUR CONTEMPORARIES

Mangoes may be preserved by covering them with latex of *Hevea brasiliensis.* Soft, juicy fruits will not quite respond to the process. Mangoes which were brought to Paris from India, so preserved, gave 60 per cent success. Concentrated latex is a better preserver than ammonia.—*International Review of Agriculture* (*The Tropical Agriculturist*).

It has been discovered in Cuba that banana fiber is better for sugar sacks than jute as the fiber does not deteriorate so quickly and more of it can be extracted from a given piece of land. Cuba is now considering the construction of a plant with a capacity of 10,000,000 banana fiber sacks for each sugar crop.

Banana stems contain an appreciable amount of potash. When used as a fertilizer either by leaving the trash on the soil or by plowing it in, beneficial results will be obtained, provided no disease is present.—*Tropical Life*

Fertilizer constituent tests recently carried on in Negros brought about the following results: Nitrogen plus potash was no better than nitrogen alone. But nitrogen plus phosphoric acid increased the yield to an average of eight (8) piculs of sugar per hectare. "At current costs per ton for calcium superphosphate or other sources of phosphoric acid, and at a price of ₱10 per picul of sugar, the application of phosphoric acid fertilizer has been profitable in the foregoing experiment."—*Sugar News*

Heavy infestations of the cotton louse which follow excessive applications of calcium arsenate are caused not by the destruction of predatory insects by calcium arsenate, but by the killing or hymenopterous parasites when they emerge in the presence of the arsenical. They are killed also, although to a lesser extent, by calcium hydroxide, calcium carbonate, and corn starch. "Initial infestations are due to the positive phototropic reaction of winged females to white substances, such as calcium arsenate, calcium carbonate, starch or flour."—*Journal of Economic Entomology.*

Young seedlings may be freed from the attacks of red ants by scattering paradichlorobenzene round each plant. The chemical should be lightly covered with earth and should not be allowed to come in contact with the plant. Kerosene, creoline, or carbolic acid may likewise be used, when mixed with sawdust. Freshly sown seeds may be protected from the attacks of these ants by broadcasting them after sowing a mixture of wheat and maize bran.—*The Review of Applied Entomology.*

It is quite a common practice in the United States to use ethylene gas for coloring mature citrus fruits and tomatoes. There is little chance of success when the fruit is immature.

"A gas-proof box is required with a close-fitting door. The box can conveniently be 6 feet high so that a man may be able to enter it to stack the cases. A small hole should be made so as to insert a thermometer, which can be placed in such a way that the bulb is within the box, while the mercury column is without, so making temperature recording a simple process. The temperature required is between 75° and 85° F., and in order to secure and maintain this in our experiments a four-bulb electric radiator was placed inside the box. This was controlled by an external switch.

"The concentration of ethylene required is 1 cubic foot of gas per 1,000 cubic feet of space, and although this mixture is not explosive, yet should the mixture by accident become a rich one there is a risk from naked flames.

"The gas is contained in a small portable cylinder, to which is attached a measuring gauge; this measures the number of cubic feet of gas passing per minute. The gas enters the box through a rubber tube which joins the measuring gauge to a small tap leading into the box. The correct amount of gas should be applied at not less than eight-hour intervals. Under the most favorable conditions in the recent experiments, we were able to colour up mature but green Valencia Late Oranges after six applications."—*The Journal of the Dept. of Agri. of Victoria, Australia.*

BOOK REVIEW

SNODGRASS, KATHARINE. Copra and Coconut Oil. 135 pp. Food Research Institute. Stanford University, 1928.

This publication is one of a series of Fats and Oils Studies. The economic phases of coconut oil in international trade are emphasized, but very little is said of its technology or chemistry.

What accounts for the timeliness of this book is the lack of reliable economic data on other than the agronomic and botanical aspects of the coconut industry, let alone the increasing use of coconut oil in the American diet. Most of the statistical data as regards the Philippines were furnished by the Bureau of Agriculture, Manila.

Contents.—Place of coconut oil among the fats; coconut cultivation and the preparation of coconut products; world production of copra and coconut oil; coconut production in Ceylon, India, the Malay States, the Dutch East Indies, Oceania, the Philippines; volume and course of international trade; utilization of coconut oil in the margarin and soap industries; market position and outlook.

Hon. JORGE B. VARGAS
Under Secretary of Agriculture and Natural Resources

Formerly Assistant Director of Commerce and Industry, Acting Director of Posts, and Director of Lands

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[1] A reprint of the article on coffee will contain more illustrations.

COFFEE CULTURE

By F. G. GALANG, *Horticulturist*

On its introduction into Europe coffee was looked upon as detrimental to morals partly because it was considered as a sort of intoxicant, and partly because it brought crowds of people together in coffee houses to talk scandal. The original name of the plant is said to have been derived from the word "*cabe,*" and the present name is a derivation from this word literally meaning that which takes away the appetite, while others believe that coffee was derived from Kaffa, where it was first grown. Now there is a coffee habit as there is an opium or tobacco habit. Most people think they cannot get along a day without coffee. At first a decoction of the berry husk was used; some drank an infusion of the pulp and coffee leaves for a beverage, and it was left to the Persians to invent the drink prepared from roasted beans.

Coffee has been in cultivation only as far back as the fifteenth century. In the Philippines it is said to have been first introduced by the Spanish missionaries during the eighteenth century. Its systematic cultivation commenced early in the nineteenth century, first in Laguna, then in Batangas and Cavite. Most of the coffee then was produced in these provinces though some was grown in Tayabas, Misamis, Camarines, and Cotabato. The best coffee was produced in Batangas and Mindanao, however.

In 1808 only a few plants were grown in Batangas province, and cultivation on a large scale did not start in Lipa and adjoining municipalities until 1859, while in 1889 disease broke out and destroyed the coffee plantations. In 1889 about two-thirds of the land in Lipa was planted to coffee, and the price rose to ₱25 per picul at one time. In Benguet coffee was first planted in 1875 by one Mr. Manuel Scheidugel, and in 1884 coffee was found growing wild in Nueva Vizcaya and its cultivation here was extended until it became one of the principal crops of the district.

The status of the coffee industry in the Philippines for the last 13 years is shown in the following table:

Year	Production	Importation	Exportation	Total consumption	
	Kilos	*Kilos*	*Kilos*	*Kilos*	*Per cent*
1915	694,900	792,684	565	1,487,019	4.87
1916	732,200	1,062,022	(a)	1,794,222	5.87
1917	594,600	1,294,920	1,393	1,888,127	6.18
1918	712,800	1,260,819	116	1,973,505	6.46
1919	717,200	892,156	(a)	1,609,356	5.27
1920	998,800	1,457,074	12	2,455,862	8.04
1921	1,062,300	1,458,637	(a)	2,520,937	8.25
1922	1,146,900	1,506,104	18	2,652,986	8.69
1923	1,155,700	1,853,857	615	3,008,942	9.82
1924	1,173,600	1,586,660	135	2,760,125	9.04
1925	1,178,200	1,452,995	(a)	2,631,195	8.61
1926	1,207,300	1,546,581	(b)	2,753,881	9.02
1927	1,209,800	1,779,495	96	2,989,199	9.79
Total	12,584,300	17,944,004	2,952	30,525,356	99.91

[a] None. [b] No report.

It is not gratifying to note that the annual importation of coffee into the Islands amounts to over a million pesos when as a matter of fact this importation could be either entirely stopped or greatly reduced. The coffee industry was a very lucrative one up to the year 1890, and until the year 1902, the Islands used to export coffee to the outside world, but this was stopped by the prevalence of diseases and pests that destroyed coffee in this country as well as in other countries in the tropics. Between 1854 and 1902, a total of 114,379,973 kilos of coffee valued at ₱33,084,858 was exported from the Philippines except in the years 1859, 1868 to 1872 and 1896 to 1897, when no exportations of coffee were made. Since then it has frequently been urged that it would be unprofitable to establish a coffee industry here because of the diseases and pests that attack it, because of the higher scale of wages here than in Java and other coffee-growing countries. Yet it is a remarkable fact that the coffee industry has managed to maintain itself in Hawaii where the wage scale is far higher than in the Islands or elsewhere in the tropics.

CLIMATE AND SOIL

There is no cause for anxiety if embarking in the coffee enterprise in the Philippines because of the favorable soil and climate conditions in many parts which are identical with those of the leading coffee-producing countries of the tropics. From what is known of the requirements of the various blight resistant coffees that are cultivated in Java, of the climate and soil in most parts of the Archipelago, it is reasonable to believe that

planted in those districts to which they are adapted and given the proper care, a number of coffees will grow and produce abundant crops. Coffee thrives best in a fairly deep soil, loose, friable, well drained and rich in vegetable matters and preferably of volcanic origin. Slopes along volcanic places are especially adapted to coffee plantations. Soils with chalk, marl and red clay texture are not suitable for this plant. Along the mountain slopes where most of the successful coffee plantations are found in Java, the soil is deep, friable, loamy, fine, rich, not sticky clay. In the coffee plantations in Hawaii the land is rolling, the soil deep and of volcanic origin, black or grayish to brownish, fertile and friable.

Coffee suffers severely from strong winds so wind-breaks should be provided against the direction of the prevailing winds when natural wind-breaks are absent. The best temperature for coffee is from 60 to 75° F and varying altitudes and rainfall are suitable according to the varieties or types of coffee.

The Arabian type is found to grow well at lower altitudes with a well-marked, short, dry season, but because of the coffee blight, *Hemileia vastatrix,* it should not be planted below 800 meters and does best up to 2,000 meters or more. In the Mountain Province below 1,000 meters elevation the Arabian coffee is attacked by the blight. Altitude alone therefore will not render this variety resistant to *Hemileia.* Soil and rainfall play important parts. It grows best on a rich, friable to even rather stiff loamy soil in a temperature of 60 to 70° F.

The Robusta type should be planted only in a rich, friable and loamy soil, and where there is a well distributed rainfall throughout the year, preferably from 2,000 to 2,500 millimeters. It requires an altitude of from 450 to 700 meters for its best development although it may be grown from sea level to an elevation of 1,000 meters.

The Liberian type grows at elevations from sea level to 700 meters. But the Liberian variety should not be grown above 350 meters. This type of coffee is drought-resistant and it may succeed in districts with a pronounced dry season and a rainfall of 1,200 millimeters. The yield will be greater, however, in places where there is a uniform distribution of rainfall. It thrives even on heavy clay soil.

The following tables show the rainfall at the Bangelan Coffee Experiment Station, Malang, Java, where the Robusta and the Liberian types are successfully grown; and at Kealakekna, the

Kona coffee district of Hawaii, where Arabian coffee is grown at a profit.

Rainfall at Bangelan, Java

Month	5-year average (1909-1913)		3-year average (1919-1921)		3-year average (1923-1925)		Average	
	Rainfall	Rainy days	Rainfall	Rainy days	Rainfall	Rainy days	Rainfall	Rainy days
	mm.		*mm.*		*mm.*		*mm.*	
January	470.62	27.8	350.83	22.6	316.33	21.0	379.29	23.8
February	396.98	23.8	328.33	18.6	263.33	20.0	329.54	30.8
March	331.62	26.0	398.66	18.0	336.33	26.6	355.53	23.5
April	313.34	19.4	250.33	14.6	233.66	15.6	265.77	16.5
May	175.92	15.4	115.16	8.0	83.33	5.6	124.47	9.6
June	109.48	12.4	80.33	6.3	59.33	4.0	83.04	7.5
July	81.18	10.0	33.33	3.3	96.33	6.3	70.28	6.5
August	31.40	6.0	68.00	6.3			49.70	6.1
September	43.90	8.4	76.00	6.3	1.66	0.3	40.52	5.0
October	249.24	18.6	126.66	7.0	163.66	6.3	179.85	10.6
November	286.44	20.6	293.66	19.0	251.33	13.6	277.14	17.7
December	376.40	22.4	401.33	20.3	315.00	13.6	364.24	18.8
Total	2,866.52	210.8	2,522.62	150.3	2,120.29	132.9	2,520.37	176.4

Rainfall at Kealakekna, Hawaii

(192 rainy days)

	mm.		*mm.*
January	84.0	August	174.0
February	87.2	September	188.5
March	94.5	October	147.7
April	112.0	November	86.0
May	161.0	December	100.5
June	161.7		
July	156.5	Total	1,373.7

The rainfall for the last ten years at the Lamao Experiment Station, Lamao, Bataan, where the Liberian, Abeocuta, Dybowskii, and the Excelsa varieties are grown quite successfully has been as follows in millimeters:

Rainfall at Lamao, Bataan

Month	1917	1918	1919	1920	1921
January			6.35		
February		5.08			
March		34.29			
April		73.66			
May	152.91	12.19	24.64	139.45	195.83
June	243.84	409.45	6.35	1,575.31	161.54
July	826.77	959.87	103.89	959.10	254.00
August	312.67	696.98	2,331.21		1,409.70
September	252.98	449.07	295.15	289.56	208.28
October	217.42	387.86	249.68	218.44	66.55
November	125.98		85.34	193.04	425.20
December	14.73	35.56	19.81	68.58	5.84
Total	2,147.30	3,064.01	3,122.42	3,443.48	2,726.94

Rainfall at Lamao, Bataan—Continued

Month	1922	1923	1924	1925	1926
January	....	9.14	34.04	....	7.11
February	....	63.50	16.76	35.56	....
March	....	42.93	13.46	4.57	6.86
April	50.80	9.65	15.49	4.32	1.78
May	264.41	523.75	122.94	144.27	203.20
June	236.22	536.96	293.88	705.36	610.36
July	892.05	378.46	826.52	720.34	357.38
August	218.95	1,379.22	765.30	1,015.49	520.70
September	480.31	449.07	179.83	519.43	396.24
October	202.69	30.48	433.07	459.49	191.53
November	42.16	477.52	165.10	35.56	39.37
December	136.40	23.37	152.15	10.92	57.40
Total	2,523.99	3,924.05	3,017.54	3,655.31	2,391.93

At La Carlota Experiment Station, La Carlota, Occidental Negros, where the Robusta and Liberian types are quite successfully grown, the elevation is about 120 meters above sea level and the soil is of sandy loam, slightly sloping and analyzing as per the Bureau of Science records from the soil samples submitted by the Bureau of Agriculture, as follows:

Chemical analysis

Water-free basis

	Per cent		*Per cent*
Loss on ignition	9.070	Potash (K_2O)	0.983
Nitrogen (N_2)	0.262	Humus	1.910
Phosphoric anhydride (P_2O_5)	0.667	Acidity ($CaCO_3$)	0.024
Calcium (CaO)	4.390		

The rainfall at La Carlota is quite uniformly distributed and generally there is but a short dry season commencing in December and terminating in April. The rainfall and number of rainy days for ten years are as follows:

Rainfall at La Carlota, Occidental Negros

Year	Rainfall in millimeters	Rainy days	Year	Rainfall in millimeters	Rainy days
1916	2,956.05	192	1922	3,208.53	188
1917	3,890.90	218	1923	3,187.70	186
1918	2,612.64	190	1924	2,969.26	200
1919	2,732.28	171	1925	3,083.24	207
1920	3,923.79	168			
1921	2,968.50	190	Average	3,103.89	191

At Lipa, Batangas, where Arabian coffee was once an export crop, the altitude is about 304 meters above sea level. The land,

which is rolling and of a clay loam in texture, analyzes as follows:

Chemical analysis

Water-free basis

	Per cent		Per cent
Loss on ignition	10.370	Lime (CaO)	1.670
Nitrogen (N_2)	0.158	Potash (K_2O)	0.995
Phosphoric anhydride (P_2O_5)	0.419	Humus	1.245
		Acidity ($CaCO_3$)	0.011

Mechanical analysis

Water-free basis	Surface soil Per cent	Sub-soil Per cent
Coarse sand (1–0.5 mm.)	1.55	0.60
Medium sand (0.5–0.25 mm.)	5.60	6.15
Fine sand (0.25–0.10 mm.)	11.20	8.45
Very fine sand (0.10–0.05 mm.)	12.05	8.05
Silt (0.05–0.005 mm.)	50.15	43.80
Clay (0.003 mm.)	19.45	32.95
Total	100.00	100.00

It should be borne in mind that the rainfall in the Philippines is rather local. Furthermore, the effect of too little and of too much rain on the development of the coffee plants should be considered. In a markedly dry season the growth of the coffee is checked but this is usually followed by an excellent crop. On the other hand if the moisture is excessive there is a tendency for the coffee plant to produce many leaves and few berries, and if there is too much rain the flowers will rot and fall without setting fruits, and they are also apt not to be properly cross fertilized. However, coffee needs only a few hours of sunshine for the complete fertilization of its flowers. Heavy rainfall is not injurious to coffee provided the soil is well drained and it does not rain during the flowering period.

VARIETIES

The principal varieties of present importance are the Arabica, which includes the Porto Rican, Padang, Bourbon, Erecta, Columnaris, Maragogipe, San Ramon, Mocha, and Murta types; the Robusta, with its allied types, Congo, Uganda, Quillou, Canephora, Bukobensis, Sankurensis, and Laurensis; and the Liberica, with its Excelsa, Dybowskii, Abeocuta, Dewevrei, and Arnoldiana types. The varieties grown in the Philippines on plantations are the Arabian, the Robusta, the Liberian, and the Excelsa coffees. Each of these varieties, as previously men-

tioned, requires a certain altitude, temperature, kind of soil and amount of rainfall; and each is to a different degree resistant to various diseases and pests. The high prices which some varieties bring and the greater productivity of others are important considerations in the selection of the variety to be planted.

With a view to rehabilitating the coffee industry in the Philippines, a comparative trial of the foreign varieties of coffee, especially of the Robusta type, and the Excelsa, Dybowskii and Abeocuta of the Liberian type, which were introduced early in 1915 by the Bureau of Agriculture from Java, has been undertaken at the Lamao and La Carlota Experiment Stations and at the Lipa Demonstration Station. The results obtained from these varieties have awakened a lively interest in the people in Batangas, formerly a noted coffee province, and there has been a growing demand for them all, but especially for the Excelsa, and for knowledge relative to their culture, requirements and degree of resistance to diseases and pests.

The planting of Arabian coffee in places where it was grown before would result only in a disappointment due to the susceptibility of the variety to the coffee blight. As regards Liberian coffee, the Bureau of Agriculture planted this variety on two or more hectares on the Roxas Estate in Lipa, and while the cultivation of this field was abandoned long ago and the coffee trees became overgrown with native vegetation yet these plants served as the main sources for seeds for Batangas province, where this variety is now widely cultivated. Although bearing trees of Robusta coffee are reported from Lipa, Batangas; Basilan, Zamboanga and Lamao, Bataan yet this variety was not introduced into the Philippines to any extent prior to 1915.

The Arabian coffee (*Coffea arabica*) is an ever-green, delicate shrub and most sensitive, not only to *Hemileia,* nematode worms and other parasites, but to variations of heat, moisture, sunlight, etc. It is a native of Abyssinia. It grows to a height of 5.4 to 6.0 meters. The leaves are oblong-ovate, smooth, about 0.1524 meter long and 0.0635 meter wide. The flowers are in dense clusters in the axils of the leaves, with a 5-toothed calyx, a tubular parted corolla, 5 stamens and a single style, white and fragrant. The berry is fleshy and as it ripens it assumes a dark red color. Each berry contains 2 seeds imbedded in a whitish pulp and inclosed in a thin membranous parchment. Between each seed and the parchment is the silverskin. The seed is convex in form and of a soft semi-translucent, bluish,

or greenish color, hard and tough in texture. This type includes several species or varieties such as the Amarilla, Maragogipe, Leococarpa, Intermedia, Stuhlomanni, Humboltiana, Rachiformis, Augustifolia, and Stranimea coffees. The Arabian variety is the highest priced and most sought for coffee on account of its superior flavor, and because it comes into bearing in about 2 to 3 years.

The Robusta type includes several species and varieties, which are quite hard to differentiate but quite distinct both from the Arabian and the Liberian types. The Quillou, the Congo, the Robusta, the Uganda, and the Canephora are grouped under the Robusta type and considered the most important coffees belonging to this type.

The Robusta variety (*Coffea robusta*) originated in tropical Africa, and at present is considered the best commercial coffee in Java though it has not so good a flavor as the other coffees. The berries ripen more slowly at higher elevations, and the trees begin to yield in about three years below 300 meters. It is quite resistant to blight but very susceptible to the nematode worm. It has variable sized berries, which makes it difficult to pulp. This variety has proved to be an excellent temporary catch-crop for rubber in Java. It became a famous variety there because it is a heavy yielder, a regular bearer and comes true to type when planted from seeds. The tree is more or less umbrella-shaped, due to the fact that the branches are long and bend towards the ground. The leaves are wrinkled, dark green and not so thin as those of the Arabica, nor so thick as the leaves of the Liberian type. Ripe berries are blood-red in color, have a flat navel with thin pulp and are smaller than the Arabica. The silverskin is brownish and rough in appearance, and adheres closely to the bean, but it is easily removed by artificial drying. Records show that the Robusta coffee was first planted here in 1900 at Lipa, Batangas, and in 1909 at the Lamao Experiment Station, Lamao, Bataan and at Basilan, Zamboanga.

Congo coffee (*Coffea congensis*) is a native of Africa and closely allied to the Arabica and yet it is classed under the Robusta type. It is a blight-resistant coffee and requires the same soil and climatic conditions as the Robusta for its best development. Its young branches are pointed upward. The leaves are smooth, light green and with winged and white pulpy berries. The berries are flat like the Arabica, and borne on a longer pedicel than the true Robusta and the silverskin is brownish and the beans smaller. It begins to bear at the age of 3 years.

Liberian coffee grown at the Lamao Experiment Station, Lamao, Bataan

The Quillou variety (*Coffea quillou*) is of African origin and is closely related to the Robusta and only exhibits a very slight difference from the latter variety. The trees are more compact and with narrower leaves and shorter internodes than the Robusta. The old leaf is a little lighter green than the Robusta and when quite young it is brownish or rusty. The berry is bright red, not dark red and the silverskin is brown not greyish like Robusta and has a thinner husk. Furthermore, the bean is less rounded than the Robusta, being proportionally longer and in some cases rather pointed. It has a better flavor, is a heavy yielder, early maturing and has more uniform beans than the Robusta. The beans are yellowish in color while those of the Robusta are blue-green. It begins to yield in about 3 years. It is rather resistant to *Hemileia*. In Java the Quillou is marketed as Robusta, which it much resembles.

The Canephora coffee (*Coffea canephora*) is a native of Africa and its berry is like that of the Quillou, which is bright or vermilion red, never dark red or bluish when ripe; when very young the berry has a bronze color and is smaller than the Robusta berry. The silverskin adheres closely to the bean and is more uniformly brown in color than the Robusta. The leaf is not emarginate towards the stalk, like that of the Robusta, but gradually tapering and comparatively narrow. The borders of the leaf are not scalloped, as in many of the Robusta type, but flat. It produces its first crop at three years and thrives well under heavy shade, which makes it a good variety under rubber. It is a blight-resistant coffee.

The Uganda variety (*Coffea ugandae*) is of African origin with small, oval and scalloped leaves, smaller than those of the Robusta. The berry is of a light red color and on a rather long pedicel like that of the Arabica. It is more resistant to the blight than the Robusta variety. It begins to bear in 3 years.

The Liberian type includes the Liberian, the Excelsa, the Abeocuta and the Dybowskii coffees, which are considered the most important varieties under this group.

Liberian coffee (*Coffea liberica*) is indigenous to Liberia, West Africa. It has an upright growth, begins to bear in about 4 or 5 years and reaches a height of about 9 meters. The leaves are about twice as long as those of the Arabica. The tree bears white or slightly pink flowers. The berries are large, round and light yellow with fine stripes in dull red. The skin is thick and the pulp is somewhat bitter and not juicy. The parchment is more woody and darker in color than that of the Ara-

bica. Ripe berries do not fall to the ground as do the Arabica and they are borne singly and in small clusters rather than in densely crowded clusters like those of the Excelsa and the Robusta types. The bean is fairly plump with a concave face furrowed with a broadly open suture, of a greenish straw color and with clay-colored silverskin. It is quite resistant to the nematode worm, but no new plantations of this variety are being set out in Java, as it has also been found to be badly affected by the blight. As it is the strongest in taste and a fine flavored coffee it is in demand for blending with other varieties. The flowers and berries are the largest in size of all the coffee varieties grown. The tree is a robust and prolific bearer. This variety was first planted at San Jose, Batangas, in 1891, at San Miguel, Tarlac, in 1898, and at the Lamao Experiment Station, Lamao, Bataan, in 1907, as per available records.

The Excelsa coffee (*Coffea excelsa*) is likewise of African origin. It bears well and is of vigorous growth with very extraordinary sized leaves, oval and more rounded than the Liberian. It differs from the latter variety as to leaves, flowers, and berries. Different types of berries are produced from the trees planted at the Lamao Experiment Station, Lamao, Bataan, but all are of good quality. As the berries vary in size this gives trouble with the pulping machines. The berries are in thick clusters and smaller than the Liberian, and of solid color. They do not fall on ripening. The pulp is firmer than that of the Arabica. The silverskin is pale brownish and a considerable portion adheres to the bean, giving it a rough and uneven appearance unless dried artificially. The bean is straw-colored. The tree bears in about 4 to 5 years, and a full crop is obtained at the age of 7 to 8 years. It is very resistant to the attack of the nematode worm, and because of its resistance to the blight and to drought it is now becoming very popular in the Philippines at lower elevations and where the rainfall is not well distributed. It approaches the quality of the Arabian coffee both in flavor and aroma.

The Abeocuta (*Coffea abeocuta*) variety is a strain of the Liberian coffee. It is not much attacked by the coffee blight. It stands between the Liberian and the Excelsa coffee in vigor and is more susceptible to the blight than the Excelsa. Its foliage, fruit and manner of growth are similar to the Liberian. The berries are medium large and with thick pulp. The tree fruits at about the same age as the Excelsa. In quality of

fruits it equals Excelsa but gives a lower yield. It is worth trying in the Philippines because of its strong flavor and vigorous growth.

The Dybowskii variety (*Coffea dybowskii*) is of vigorous growth. It is very similar to the Excelsa with its longer internodes, larger leaves, and closely clustered berries. The leaves are large, oval and of heavy texture. The berries are large and with rather thick pulp.

The hybrids, Kawisari B and D, are becoming very popular varieties in Java because of their immunity to the blight and their excellent flavor. They are the natural hybrids of the Liberian and the Arabian coffees, and for this reason are not a pure strain, and are usually propagated by grafting. These two hybrids are said to stand unfavorable soil and climatic conditions, and are of vigorous growth, healthy and constant croppers. The berries when ripe do not fall so easily as do those of the Arabica. They do well under the same conditions as the Liberian and the Robusta types.

A hybrid between the Congensis and Uganda coffees has been recently developed in Java and is said to be a good yielder at the Bangelan Coffee Experiment Station, Malang, Java.

HYBRIDIZATION

The first variety of commercial importance was the Arabica and then came the Liberica, which variety is being replaced by the Robusta in Java and it may not be long before the hybrids, Kawisari B and D or some other strains of coffee, will take the place of the Robusta. Hence the importance of developing new varieties or strains of coffee to replace the old ones to assure the right planting materials for future plantings. Varieties that are reported to stand the blight at present may become susceptible to it after long and continuous cultivation in the same locality.

Hybridization in coffee takes place freely and large numbers of hybrids may be obtained without resort to the more tedious method of hand pollination. Bees and other insects are not absolutely essential for the fertilization of coffee flowers, for even when coffee flowers have been bagged to exclude insects, berries have been formed. It has been noticed, however, that in cases where insects, especially bees, were absent or few during the flowering time, the crop was small in proportion to the number of flowers.

Fertilization takes place just before the flower bud opens, when it will be found that the lobes of the stigma are just beneath the apex of the bud, and far out of reach of the anthers; and on its opening, the petals and anthers fall away from the stigma, which stands erect and protrudes far out from the corolla. Hand pollination of coffee is done in the same way as with other plants, viz., the male parts are removed to render the flower essentially female, which is done before the pollen matures; then the pollen taken from the male parent is applied and the cross-fertilized flowers bagged so as to exclude any foreign pollen which might be carried by insects or some other agency.

SELECTION AND PREPARATION OF SEED

The seeds for planting should be carefully selected and only the best, full grown and well shaped beans planted. For if poor seeds are planted low yielding trees are the result. In selecting seeds and budsticks a planter must bear in mind the following points:

1. Productiveness
2. Quality
3. Resistance to diseases and pests
4. General vigor
5. Adaptability to soil and climatic conditions
6. Season of crops

At the Bangelan Coffee Experiment Station, Malang, Java, the following procedures are followed in segregating the best yielding trees in order to eliminate all possible variations:

1. From 100 to 200 seedlings are raised from one mother tree and these are set out in a trial plot.
2. From the 100 or 200 plants only 10 to 20 trees of healthy good yielders are selected. The yields, characteristics and behavior of the selected plants are recorded for 3 or 4 years.
3. Again from the 10 to 20 trees the five best plants are selected. Then budwoods for grafting are taken from the chosen trees.
4. From 16 to 20 grafted plants each of the five selected trees are established in a museum garden as they call it. The records of production and behavior are kept as usual.
5. From the grafted trees they next select from 40 to 50 trees from which they draw plant materials for propagation, and plant these in a multiplication plot.
6. Trees are selected from the multiplication plot and these are set out to the hectare-garden as they call it. All of the trees are grafted, and from the resulting best plants from this grove they make or draw their materials for the plantations.

The following shows the yields in kilos of clean coffee obtained from the different strains of a hybrid coffee and some of the best yielding Robusta coffee at the Bangelan Coffee Experiment Station, Malang, Java:

Yields of No. 124.01 Robusta x Uganda coffee

(Two generations of grafted trees)

Tree No.	Yearly yields in kilos of clean coffee							
	1918	1919	1920	1921	1922	1923	6 years average	4 normal years average
1	2.254	0.950	0.167	2.334	3.468	2.088	1.877	2.536
2	3.212	1.065	2.153	2.490	3.607	1.539	2.344	2.712
3	1.352	0.675	0.140	1.969	2.010	1.685	1.305	1.504
4	2.131	0.631	0.851	3.350	3.510	1.187	1.943	2.544
5	1.334	0.741	1.222	2.864	1.601	1.208	1.495	1.727
6	0.931	0.430	0.731	2.951	1.597	0.694	1.222	1.543
7	1.471	0.196	0.488	2.322	6.836	0.413	1.954	2.760
8	3.874	0.770	1.482	1.156	1.032	0.989	1.550	1.763
9	1.796	0.528	0.371	1.853	2.404	0.649	1.267	1.928
10	1.573	0.346	1.958	3.036	4.718	1.787	2.236	2.778
11	0.944	0.322	0.397	1.560	1.687	1.667	1.096	1.464
12	2.472	0.287	0.887	1.869	3.308	0.623	1.574	2:068
13	2.587	0.640	0.702	2.008	2.732	1.221	1.648	2.187

The low yields reported in 1919 and 1920 were due to the eruption of Mt. Klut, when many of the trees wilted, and to the appearance of the coffee beetle in 1920, which is now a dangerous pest in Java.

Coffee No. 124.01 is a hybrid between the Robusta and the Uganda coffee seedling No. 1, which is a good tree from seedling plantation, and No. 124 is the mother tree at the Bangelan Coffee Experiment Station, Malang, Java. This hybrid produces uniform beans that are easy to pulp and hull. Not all the mother plants possess good grafting qualities—some are poor while others are good and take easy when grafted with other coffee plants, it is said. This particular hybrid, however, has good grafting qualities.

Yields per tree in kilos of clean coffee of the best yielding Robusta coffee in Java

Mother tree	Year planted	Yearly yields in kilos of clean coffee						
		1913	1914	1915	1916	1917	1918	Average
Robusta-78				2.689	5.017	3.035	5.553	4.074
Robusta-124.01	1908			2.991	9.949	0.822	2.530	4.074
Robusta-83	1904		3.846	2.995	6.173	2.727	6.020	4.342
Robusta-105	1901	4.230	6.279	4.238	6.958	7.192	5.218	5.686

The highest yielding of the Liberian and Excelsa coffees at the Lamao Experiment Station, Lamao, Bataan, are tabulated as follows:

Highest yielding Excelsa coffee

Tree No.	Yearly yields in kilos of clean coffee									
	1919	1920	1921	1922	1923	1924	1925	1926	1927	Average
FIELD–E										
R1T1	0.02	....	1.21	4.07	1.59	5.15	5.04	6.30	1.32	3.09
R1T6	0.05	....	1.16	1.39	2.93	1.56	4.64	2.89	1.42	2.01
R3T5	....	....	4.00	1.10	2.37	....	3.80	2.45	2.41	2.69
R4T1	....	....	0.13	2.32	2.59	6.57	1.96	4.02	....	2.93
R4T4	....	....	2.85	3.30	4.21	1.14	3.10	1.57	1.80	2.56
R5T2	0.01	0.63	1.62	4.19	1.00	2.08	3.67	5.42	0.80	2.16
R7T2	....	....	1.99	3.13	1.12	4.47	0.84	8.57	0.20	2.90
R8T6	0.08	....	0.53	4.52	....	0.18	5.84	3.67	6.12	2.99
R8T8	0.12	0.75	1.56	2.96	0.69	5.00	2.72	4.02	....	2.23
R9T3	....	0.05	1.57	3.40	6.67	0.60	3.12	4.37	....	2.82
R9T6	0.04	....	1.38	1.77	5.38	5.01	0.73	3.15	3.02	2.56
R12T2	....	0.17	3.74	2.10	5.30	2.11	0.87	5.07	....	2.76
R12T3	0.14	0.29	0.88	3.11	1.74	2.29	7.80	0.52	4.00	2.31
R12T8	....	0.04	0.70	1.16	2.59	4.90	....	8.05	....	2.91
R13T1	....	0.33	2.90	3.78	1.62	3.50	1.00	6.47	....	2.80
R13T2	....	0.04	1.25	1.91	2.64	1.92	2.16	4.50	....	2.05
R15T6	0.10	0.30	1.27	2.55	1.73	6.80	1.84	6.05	....	2.58
R16T8	....	0.65	0.44	1.80	0.16	10.35	....	2.27	....	2.56

Highest yielding Liberian coffee

Tree No.	Yearly yields in kilos of clean coffee						
	1922	1923	1924	1925	1926	1927	Average
FIELD–E							
R1T3	0.67	0.50	3.58	1.98	6.40	2.69	2.64
R2T6	0.28	1.33	3.44	2.24	4.16	2.22	2.28
R2T8	....	....	0.81	3.13	2.72	1.97	2.23
R3T8	....	....	0.89	2.88	3.45	4.00	2.81
R6T2	1.89	0.63	3.44	3.02	4.48	....	2.69
FIELD–P							
R4T10	....	....	0.40	1.53	5.28	....	2.40
R4T11	....	....	1.63	1.88	2.56	....	2.02
R4T12	....	....	4.00	2.24	3.84	....	3.36

In field "E" the Liberian coffees No. R1T3 and R2T6 and the Excelsa coffees No. R1T1, R1T6, R5T2, R9T6 and R12T3 were regular bearers.

In Java, seeds for planting are never allowed to pass through the pulping machine but instead the husks are bitten by women, then the beans washed in fresh water with sand or ashes to remove the slime, as if this were not removed the seeds might start to ferment. The seeds are then air-dried under shade. Sometimes they are dusted with powdered charcoal to hasten their drying before any fungus infection. At the Lamao Ex-

periment Station, Lamao, Bataan, the husks of the seeds for planting are removed by breaking them between two boards nailed together at one end, which method is believed more convenient than that practised in Java.

Coffee seeds if kept in a dry atmosphere very quickly lose their germinating power, due probably to the evaporation of part of their moisture content. Therefore seeds that can not be sown at once should be preserved in moist charcoal, moss or sand placed in air-tight containers. Moist moss is the best as found from the tests conducted at the Lamao Experiment Station, where the seeds have kept viable for 15 months. The highest percentage of germination was obtained during the tenth monthly test—94 per cent; and 60 per cent germination in the last or the sixteenth test.

PROPAGATION

Coffee is propagated by seed and by budding or grafting. The first method is the commonest, but in Java grafting is now being employed more extensively in starting new plantations and in rejuvenating the old ones.

The land to be selected for seed bed and nursery should be well drained, having a rich, loamy soil. With ordinary rainfall a light bamboo frame should be erected above the nursery about 2.5 meters high, and covered with split bamboo, cogon, or other grasses or palm leaves to provide half shade. If the rains are so heavy that they are likely to wash out the coffee seeds, they should be sown under a rain-proof shelter. The land should be spaded thoroughly to a depth of about 30 centimeters, and all stones, roots, and trash removed. From 1 to 1.5 meters is a convenient width for seed and plant beds. The beds should be about 10 centimeters or so higher than the general level of the ground because of the danger from flooding during heavy rains.

Provided that the seedlings can be promptly transplanted to the nursery bed after germination, the coffee seeds may be broadcasted at the rate of 2,000 to 2,500 seeds to the square meter; but if the transplanting cannot be promptly attended to, it is best to spread the seeds over an area twice as large in order to produce strong plants. The seeds should be covered with not more than one centimeter of earth, and then watered thoroughly. Unless the rains provide sufficient moisture the seed bed should

be well watered from time to time, whenever the soil appears dry. Frequent sprinklings, light enough for the water not to penetrate more than a few millimeters below the surface of the soil, are harmful rather than beneficial both in the seed bed and in the nursery, in that they encourage a shallow root system.

As soon as the first pair of leaves are fully expanded the seedlings should be transplanted to the nursery beds, which should be prepared like the seed beds. If the land is poor it is well to spade in a liberal quantity of well-decayed manure or compost. The plants should be taken up carefully, the injured tap roots nipped off before transplanting and then transplanted with the aid of a pointed stick or small dibber, spacing them from 15 to 20 centimeters apart each way. In doing this, great care should be exercised to make the holes sufficiently wide and deep so that the roots are pointed downward, and not doubled up in the hole; that the soil is well packed around them, and that the plants are not set out deeper than they grew in the seed bed. More plants should never be removed at one time from the seed bed than can be conveniently transplanted before they show signs of wilting, and the plants dug up should not be left exposed until the roots dry out. The plants should be thoroughly watered before and after transplanting, and the beds kept free from weeds and watered as often as necessary.

Considerable variation has been found in coffee grown from seed, and it is becoming generally recognized that budding and grafting from the individual superior trees must be resorted to in order to obtain the best results. In the case of the hybrids this operation is in fact absolutely necessary, since all the hybrids that have fruited so far in Java failed to come true to seed and produced an exceedingly variable progeny, which in most cases was inferior to the hybrid parent.

Budding.—First make a vertical cut through the bark up to the cambium layer of the stock, and a horizontal one at the bottom of it to form an inverted T. Open the cut or split bark with the blade of the budding knife when the bud is to be inserted. Cut two to four centimeters of the bud from the budstick by means of a sharp knife, leaving only a very small bit of wood under the bud for its protection. The bud should be cut clean with no broken tissues, and inserted immediately in-

side the opened bark of the stock. It should be pushed upwards in order that no water may enter the cut. After the bud is inserted the whole wound should be wrapped in waxed cloth or tape sufficiently tight to bring the bud in touch with the cambium layer, but not too loosely or too tightly, lest the growth be adversely affected, or as in fact often happens, prevented entirely. The wound should be wrapped up to exclude the possibility of the injurious effects of dirt, moisture and air.

The buds are to be set at least 6 inches above the ground in order to prevent the stem from growing crooked and wild sprouts from appearing, to insure a strong stand, to enable the plant to withstand any disease which might affect the roots; and also to counteract, to a certain extent, the evils of too deep planting, when the trees have been set out in orchard form.

After 12 to 15 days from the date of the insertion of the buds, they may be examined to see if they have taken, or callused. If so, the wrapping should be carefully unwound until below the bud and an inspection made of each bud. The wrapper should not be allowed to remain too long around the buds, as there is a possibility of them getting overgrown by the bark of the stock, and then the natural attempt of the young growth to push out will be frustrated. When the bud has started to grow the stock may be half cut at a height of 6 inches or so and bent downward to induce the growth of the bud; and when the young bud is well developed into a young tree the top of the stock can be separated entirely by cutting close to the angle formed in the union between the stock and the scion. All wild sprouts, or what are oftentimes called water sprouts, should be removed as fast as they appear in order to facilitate the rapid development of the newly budded plants.

Cleft grafting.—Cleft grafting may be resorted to when the stock plant has developed to a buddable size or in the top-worked tree at once. The operation is performed as follows:

After the entire top is removed split the stock downward with a sharp knife or other suitable implement. The split should be neither too deep nor too shallow, but just deep enough for the cut part of the scion or a little more, and this can be held open by allowing the wedge portion of the knife or other grafting tool to remain in the cut portion of the stock. The scion is then cut at the base in a wedge shape. The cut should be made nar-

rower toward the base similar to the "bamboo tongue" of the clarinet. The scion is then inserted into the cut portion of the stock with the thin portion toward the inside of the cleft, but care should be taken that the cambium layers of the stock and the scion should be in contact with each other. One or more scions can be inserted in the top-worked tree. The wounded portions of the stock should be sealed with grafting wax after the inserted scion and the stock have been wound together with a tape, raffia or any other suitable material. In Java they use raffia fiber in tying the grafts after two pieces of bamboo have been placed on both sides of the grafts for their protection, and no wax is employed. The tip portion of the scion should be waxed. Delicate scions like coffee should be covered with manila paper or some other kinds of paper or with light cardboard so as to form a loose cylinder around the union extending a little above the tip of the scion. This should then be filled with moist moss or sawdust to prevent drying from the excessive heat of the sun. Banana petiole is also very serviceable in case no moss is available. In Java with newly grafted plants, the scions are covered with glass tubes for their protection from heat and moisture. Any of these coverings can be removed as soon as the graft heals, which will be in about 12 to 15 days.

Scions.—Only terminal branches should be used for scions in budding or grafting the coffee plant, for if budded or grafted with a horizontal scion the resulting plant always develops into a low spreading bush and never produces vertical growth. In budding and grafting, too, success can only be attained by employing non-petioled budwood. By non-petioled budwood is meant a scion where the leaves have dropped off previously or naturally. In order to induce the plant to produce more vertical branches it is necessary to cut off some of its horizontal branches.

Stock.—The stock plant should be ready for budding and grafting when it reaches the size of a lead pencil, provided a small budstick with a small bud is cut for insertion. One-half inch in size is the best for stock. The stock plants should be raised from selected seeds. At the Bangelan Coffee Experiment Station a hybrid coffee, No. 124.01, between the Robusta and the Uganda, has been found to be a good stock because of its

vigorous growth. Other results of their stock test are tabulated as follows:

Stock test at the Bangelan Coffee Experiment Station, Malang, Java

Scion	Stock	Year planted	Yield per hectare in kilos of clean coffee					
			1913	1914	1915	1916	1917	1918
Robusta No. 105	Seedling	1909	625.1	219.1	772.1	992.6	1,003.1	158.8
Do	do	1912				1,234.1	1,405.6	592.9
Do	do	1913			370.3	1,309.4	782.6	1,149.4
Do	do	1914				268.8	1,050.5	1,086.5
Do	Excelsa	1917						
Do	do	1918						
Do	do	1919						
Do	Uganda	1919						
Robusta No. 83	Excelsa	1907						
Do	do	1908						
Do	do	1914						
Do	do	1919						
Do	Robusta							
Robusta-124.01	Seedling	1917						
Do	Excelsa	1917						
Do	Canephora	1916						
Robusta No. 78	Seedling	1915						196.0
Do	Excelsa	1919						
Do	Laurentii	1915						

Scion	Stock	Year planted	Yield per hectare in kilos of clean coffee					
			1919	1920	1921	1922	1923	Average
Robusta No. 105	Seedling	1909	347.2	125.3	2,179.1	711.2	515.9	749.9
Do	do	1912	442.4	64.4	1,614.9	922.6	529.2	850.8
Do	do	1913	7.4	14.4	474.3	616.7	402.5	569.7
Do	do	1914	121.6	73.5	850.9	802.6	606.3	607.6
Do	Excelsa	1917			0.7	784.0	100.1	294.9
Do	do	1918			57.4	677.6	156.1	297.0
Do	do	1919				105.7	293.7	199.7
Do	Uganda	1919			51.1	395.5	256.2	234.3
Robusta No. 83	Excelsa	1907			243.6	508.2	183.4	311.7
Do	do	1908			1,566.6	636.3	330.4	844.4
Do	do	1914			756.6	853.3	478.0	695.9
Do	do	1919				324.1	457.1	390.6
Do	Robusta				448.0	288.4	183.4	306.6
Robusta-124.01	Seedling	1917	73.5	57.4	282.8	621.6	149.8	237.0
Do	Excelsa	1917			207.9	845.6	291.2	448.2
Do	Canephora	1916		207.9	1,859.2	970.9	674.1	928.0
Robusta No. 78	Seedling	1915	88.2	80.5	1,259.3	1,694.7	886.9	700.9
Do	Excelsa	1919				175.7	319.9	247.8
Do	Laurentii	1915		43.4	280.7	690.9	634.9	412.5

Tape.—The tape for tying budded or grafted plants is prepared by using cotton cloth that tears easily. This should be torn into pieces about 25 centimeters wide and the strip of cloth wound tightly around a stick about the size of a lead pencil until about three centimeters in diameter; for if the rolls are larger than this the melted wax would with difficulty penetrate through the cloth. To prevent the unwinding of the rolled cloth it should be tied at both ends with string. These rolls should be kept submerged in the melted wax until completely satur-

ated, or say from 20 to 30 minutes. The best test of course is to wait until they sink. The wax is prepared by melting together equal weights of beeswax and resin in an empty biscuit can, or an iron pot if obtainable. It is not necessary to boil the wax and resin. Some people prefer to use resin, lard and beeswax, but lard is not at all necessary, since a good tape can be made as described above. If resin is not to be had, wax can be made with beeswax and some of the best paraffin candles, melted together as in the former case. After all these processes have been gone through, the tape is ready for use. It is only necessary to tear off the strips desired when budding or grafting.

SELECTION, CLEARING, PREPARATION AND PLANTING OF THE LAND

Selection of land.—In selecting a place for coffee the points to be considered are as follows:

1. Elevation
2. Rainfall
3. Temperature
4. Appearance and character of the soil and subsoil (chemical and physical condition)
5. Area: virgin or used for other crops previously
6. Drainage
7. Water availability
8. Character of the present and former vegetation
9. Exposure to sun and wind
10. Transportation facilities

Clearing and preparation of land.—On land overgrown with trees and shrubs the vegetation should be cut and burned during the driest period of the year, and the small stumps grubbed and burned together with the remaining logs. After this is done the land is ready for staking and planting, and terracing if the latter is necessary. Cogon land must be plowed and cross-plowed and planted to legumes a year in advance of the planting of the coffee in order to destroy the cogon and improve the soil. By this method, the plantation can be cultivated by animals and the cost of weeding is greatly lessened or reduced to the minimum. The holes are dug from 80 to 100 centimeters deep and 40 to 60 centimeters in diameter, the size of the holes depending of course upon the character of the soil, and the size of the plants to be transplanted.

Planting.—Small seedlings having 5 to 6 pairs of leaves can be transplanted with or without a ball of earth with equally good

results, but if larger seedlings are to be transplanted it is advisable to provide each with a ball of earth in order to prevent a set-back of the plants, due to disturbance of the roots. About one-half of the foliage should be cut, and a trench dug at the end of the nursery bed, with a depth of about 20 centimeters or more, depending upon the development of the roots. Then a thin, sharp bolo or spade should be passed through the soil, underneath and around the plants, neatly severing all straggling roots and leaving the plant in the center of an oblong ball of earth. If the soil is so loose that it falls away from the roots when the plant is removed from the nursery, great care should be taken not to allow the roots to dry out; and to set out the plant so that the roots will not be matted together in the center of the hole, but spread out in their natural position. The holes should be filed only with surface soil. In the course of planting, the soil should be worked in, and firmly packed about the roots, and the plants should be set out in the field at the same depth as in the nursery. Due care should be taken not to break the soil. Transplanting should be done preferably at the beginning of the rainy season to enable the seedlings to become rooted before the dry season. Young plants should on no account be transplanted during the dry weather unless irrigated, as a few days' hot sun will be fatal to them.

The distance from each other at which the plants are to be set out should be given careful consideration, as, if too close, the plants would be crowded, and the lower branches, deprived of sun, will shed their leaves and fall; and if the distance is greater, the shade of the plants would not be sufficient to decrease soil erosion and evaporation of moisture and there would be a waste of land. The different coffee varieties should be planted at distances as follows, according to more or less favorable conditions for their development:

Variety	Distance	Number of plants per hectare
	meters	
Abeocuta	3.5 × 4.0	714
Arabian	2.5 × 3.0	1,333
Canephora	2.5 × 3.0	1,333
Congo	2.5 × 3.0	1,333
Excelsa	4.0 × 4.5	555
Dybowskii	4.0 × 4.5	555
Liberian	3.5 × 4.0	714
Quillou	3.0 × 3.5	952
Robusta	3.0 × 3.5	952
Uganda	2.5 × 3.0	1,333

SHADE

Coffee is a shallow-rooted plant with most of the lateral roots feeding or absorbing plant foods near the surface of the ground though with the tap root penetrating fairly deep into the soil; hence the necessity of growing coffee under shade at certain elevations. The shade tree tends to keep the moisture and supply humus in the soil when their leaves drop off. In Ceylon and Indo-China coffee in many cases is planted without shade. The amount of shade to be provided in a coffee plantation depends upon the altitude; and then again, less shade is needed where the sky is frequently overcast than where it is clear. As a rule coffee is shaded most heavily at the lowest elevation where it is grown, the need for shade decreasing with the rise in altitude. Opinions vary as to the best and most suitable trees for coffee shade. A particularly good shade in one locality may not prove so in another district. Trees that do not grow so large, having a maximum spread of branches to shade a large area, with fine leaves and not deciduous are preferable for coffee shade wherever they grow. Besides, they should be sub-soil feeders and capable of enriching the soil, not susceptible to diseases and pests attacking the coffee; capable of standing against strong winds, quick-growing and long-lived plants, and with a big leaf fall and suitable to the soil and climatic conditions of the place.

In Java, ipil-ipil, *Leucaena glauca,* dapdap, *Erythrina lithosperma,* and acacia, *Pithecolobium saman,* have been found to be the best plants for shade, in the order named. In other countries, the guama, *Inga vera,* and *Inga laurina,* the silk oak, *Grevillea robusta,* the ratamara, *Albizzia moluccana,* the matadiya, *Adenanthera pavonina,* and the bukare, *Erythrina micropteryx,* have been found serviceable. While it seems probable that the ipil-ipil will be equally good for coffee shade in the Philippines as in Java judging by the results obtained at the Lamao Experiment Station, Lamao, Bataan, still there may be exceptions to this rule. In Bukidnon and Basilan, Mindanao, for instance, the dapdap appears to be better than the ipil-ipil; in Lanao, Mindanao, the silk oak and the dapdap appear to be desirable, while in Batangas it is the madre-cacao, *Gliricidia maculata.*

In a limited way fruit trees, such as the soursop (guanabano), coconut, custard apple (anonas), breadfruit, avocado, etc., may also be used as shade trees for coffee.

A field planted to Excelsa coffee, Lamao Experiment Station, Lamao, Bataan

The easiest way of setting out ipil-ipil for shade trees is to make cuttings from 2 to 8 centimeters in diameter, one or more meters long, from the tops of old ipil-ipil trees, of well-matured growth, and insert them in holes made by a crowbar, packing the soil well around them so that they remain firm in the ground. About 85 per cent of the cuttings may be expected to grow. Dapdap and acacia cuttings may be treated in the same way as the ipil-ipil but the cuttings should be not less than 5 centimeters in diameter.

If the shade trees are propagated from seeds, prepare a seed bed, sow and cover the seeds thinly with fine soil, in rows from 20 to 25 centimeters apart, at the same time the coffee seeds are sown, or shortly thereafter. When the plants are needed for planting out cut them back to a height of one meter and transplant with the aid of a crowbar as already described.

Shade trees should be planted in advance so as to provide the proper shade at the proper time. If no such shade trees have been planted far in advance, and the permanent shade trees are not large enough to provide sufficient shade, a temporary shade shoud be planted at the same time when setting out the coffee seedlings in the field. Ipil-ipil, dapdap, or some other quick-growing plants, like the cadios, *Cajanus indicus,* the castor bean, *Ricinus communis,* and *Tephrosia candida,* which are easily eradicated and not likely to become weeds, except perhaps the ipil-ipil, all produce heavy growths of leaves for mulch and make excellent temporary shade for coffee. Ipil-ipil and dapdap should be planted alternately with the coffee plants when used as temporary shade, and a few seeds of cadios, castor bean, or *Tephrosia* should be sown or dropped in holes on both sides of each coffee plant along the rows, say a foot from the coffee. This will provide enough temporary shade until the permanent ones are well established.

The papaya makes a good temporary shade plant, but bananas being voracious feeders should not be used for this purpose. As the growth of coffee and shade progresses and the shade becomes excessive, the temporary shade plants should gradually be thinned out until finally only the permanent shade trees remain.

Trees for shade should be planted with the coffee plants as indicated in the following diagram:

Diagram of the field

b		*d*		*b*		*d*		*b*		*d*
	a		*a*		*a*		*a*		*a*	
c		*b*		*c*		*b*		*c*		*b*
	a		*a*		*a*		*a*		*a*	
b		*d*		*b*		*d*		*b*		*d*
	a		*a*		*a*		*a*		*a*	
c		*b*		*c*		*b*		*c*		*b*
	a		*a*		*a*		*a*		*a*	
b		*d*		*b*		*d*		*b*		*d*
	a		*a*		*a*		*a*		*a*	
c		*b*		*c*		*b*		*c*		*b*

a—represents the coffee plants.

b—represents the shade trees to be thinned out after three years depending of course upon their development.

c—represents the shade trees to the thinned out after five years according to their development.

d—represents the shade trees left for permanent shade.

It is always advisable to plant shade trees rather closely and then to gradually cut away first the surplus branches, then the trees as indicated in the above diagram in order to provide a reasonable shade for the coffee plants for their best development. If the permanent shade trees are allowed to develop too thick and with too heavy branches the coffee plants will grow tall with less branches and with longer internodes, and they will bear few berries, for too much or too little shade means reduced crop. And dampness also favors the development of fungi. After the elimination of all the unnecessary shade trees, the branches of the permanent ones should be pruned off whenever necessary. Pruning should be done on every other row.

CULTIVATION

The land should at all times be kept free from weeds either with cultivators or by hand-hoeing. On level and well-cleared land, cultivation for the first few years should be performed by animal-drawn and shallow cultivators, supplemented by hand-hoeing. In the hilly plantations, weeding should be done by hand. In hand-weeding soil mulch should always be established at least around the trees. The weeds should be left in the field for mulching.

Cultivation should be done preferably for a few days after the rains so as to conserve as much moisture as possible, which

would otherwise be lost by evaporation. Care should be taken so as not to injure the roots and branches while cultivating the open spaces between the coffee plants. When the coffee and shade plants are fully developed only an occasional hoeing is necessary, and anyway it would then be difficult to cultivate the plantation by animal-drawn cultivators without injuring the roots of the plants. At this time the dried leaves of the shade trees will help to maintain the soil tilth and mulch.

COVER CROPPING

Except when the land is exceptionally rich, it will be found advantageous to plant the vacant spaces between the coffee to some legumes for the first four years or until the land is well shaded by the coffee and the shade trees. Cover cropping will minimize the cost of weeding, prevent soil erosion, and the rapid evaporation of soil moisture; and if leguminous crops are planted it will enrich the soil. Cowpeas, mungos, peanuts, soy beans, Lyon beans, patani, marutong, indigo, *Crotalaria, Tephrosia, Calopogonium, Centrosema, Pueraria, Vigna oligosperma*, etc., are some of the leguminous crops that are worth trying.

In Java ipil-ipil is planted on the edges and exposed places of the plantation, and in some cases on steep land ipil-ipil seeds are sown in a semi-circular form in front of the coffee tree toward the bottom of the hill to prevent soil wash, and the ipil-ipil is continuously cut down to not more than 2 feet high. All the cut and dead branches are buried in the ground for green manuring.

TOPPING AND PRUNING

If coffee trees are allowed to grow tall without topping, the harvesting and the treatment for diseases and pests will be very difficult, and they are also very liable to be blown down by strong winds. Furthermore, untopped trees have the peculiar habit of growing their branches near the ground and at the top, leaving the middle bare or nearly so, which decreases the productivity of the plant. Top the trees when they are from 2.5 to 3.5 meters high—depending upon the variety—and keep them at this height and allow no more than three stems to sprout from the ground by removing all superfluous suckers. This is to be done while the sprouts are still young for at this stage they are still easily broken. All wild or water sprouts should be removed immediately so that long and spreading branches may be produced and the trees be more fruitful. Unpruned, neglected trees can not possibly yield a very profitable crop

and it is almost impossible to restore them at once. To induce the growth of more lateral branches, topping should be performed while the plant is still young or when it has made a growth of about a meter high.

Pruning in order to be of benefit should be done immediately after harvesting the crop and should be finished before the flowering season. In pruning clean cuts should always be made so that healing may take place at once, and all wounds should be painted with white lead or coal tar after the pruning has been performed to prevent the invasion of insects and fungi.

DRAINAGE AND IRRIGATION

Where the land slopes and the texture of the soil is of such a nature that it is easily washed away by rains terracing should be done. Trees in such areas will suffer from diseases and the yield fall off considerably. The terraces should follow the contour of the land, and should be so arranged as to hold the rain water and prevent soil wash. According to the slope of the land the terrace may be made wide enough for planting one or two rows of coffee plants, interspaced with shade trees according to the need. In terracing the planting of cover crops and grasses on the slopes other than cogon should be undertaken to prevent the rapid washing of the terraces. On level land building contour drains is very effective in preventing soil wash. Another object in constructing ditches for draining off the extra water is to permit just enough water to penetrate through the soil and to provide proper aëration of the soil. Lack of drains has been the cause of the rapid decline of many plantations in the Islands, especially coconut plantations. The main drains should be dug sufficiently wide and deep to carry off land surplus water, and laid in the direction of the natural flow of the surface water and at a suitable distance apart. The lateral drains should follow the contour of the land and should contain pits here and there to catch the surface soil that may be carried down by the water. The drains should be regularly cleared.

In Java and Sumatra soil-pitting or catch drains are constructed on undulating or hilly lands to prevent soil erosion and to hold back the rain water. A catch drain of 6 x 2 x 1½ feet is dug between the rows or where the water accumulates during the early stage of planting or even before planting.

No irrigation is necessary if the plantation is to be located where the soil and climatic conditions are proper for the best

development of the coffee variety to be planted. However, in a district where there is a prolonged dry season, irrigation becomes indispensable for the coffee plant in order to prolong its life. The Indian Scientific Agriculturist (No. 6, Volume 3, June, 1922) says as follows: "The minimum of rain for bringing out coffee blossoms wholly at one time is one inch. Of course, it does not matter if it should be 25 per cent less if the season is well advanced, and the buds consequently forward. In exceptional cases handsome crops have been known to result from precipitation of no more than 30 to 40 per cent."

In the irrigation test conducted at the Lamao Experiment Station in which Excelsa and Liberian varieties were irrigated twice a month during the dry season at the rate of 10, 20, 30, 40, and 50 gallons of water per tree in a basin system, it was found that the amount of water necessary depended to a large extent on the intensity and length of the dry season and partly to the drought resistance of the variety. The Excelsa resisted the drought better than the Liberian variety during the test. The results obtained from the irrigation test were as follows:

Yield of irrigated versus non-irrigated coffee

Variety	Yield of clean coffee per tree			
	1924	1925	1926	Average
	Kilos	*Kilos*	*Kilos*	*Kilos*
Excelsa (irrigated)	2.073	1.746	2.042	1.953
Excelsa (non-irrigated)	1.621	3.053	1.735	2.136
Liberian (irrigated)	2.142	0.770	2.144	1.685
Liberian (non-irrigated)	1.532	1.8C6	2.453	1.930

The average yield of the irrigated Excelsa and Liberian coffee as given in this table was not materially affected by the irrigation water, yet in general the physical condition of the irrigated trees was improved greatly compared with that of the non-irrigated trees. This was manifested by the yellowing and slight wilting of the leaves and the stunting of the non-irrigated trees during the dry season, which conditions did not exist among the irrigated trees.

Flowering and the formation of the berries of coffee at the Lamao Experiment Station take place when the coffee trees are still in excellent condition as there is yet sufficient soil moisture for the need of the plants. And as the irrigation water is applied only during the hottest part of the year—March and April—then naturally very little benefit is derived from it by the coffee plants in their production of berries.

MANURING

In the Agricultural News (No. 514, Volume 21, January 7, 1922), there is published an account as to the annual requirements of 1,000 coffee plants at different ages for nitrogen, potash, and phosphoric acid—the most important constituents taken up by them from the soil, as follows:

Age of tree	Nitrogen	Potash	Phosphoric acid
	Kilos	*Kilos*	*Kilos*
First 4 years	4.477	10.713	1.129
From 5 to 8 years	16.193	34.890	8.876
From 9 to 20 years	13.095	20.788	7.148
After 20 years	2.3.9	13.848	4.277

The percentage of nitrogen taken up by the coffee plants from the different fertilizers, as published in the Indian Scientific Agriculturist, No. 6, Volume 7, June 1926, is as follows:

Nitrate of soda	100
Sulphate of ammonia	75
Nitrolim	69
Dried blood	65
Horn shavings	65
Green manure	65
Fish manure	60
Bone meal	60
Farmyard manure	40
Leather waste	25

By proper crop rotation the fertility of the soil is more or less conserved and not reduced to the same extent as when the land is planted to the same or to a permanent crop like coffee; and as the coffee plant draws the same kind of plant foods away from the soil, it is but logical that the soil should become poor in the particular plant foods required by this plant. Coffee is reported to be a voracious nitrogen feeder and therefore this element should be given first consideration. The addition of nitrogen to the soil is done either by planting cover crops and plowing these under when fully mature or by adding artificial manures or fertilizers. The question of determining what fertilizers are to be applied for coffee and how to use them to the greatest advantage to the plant is a most important problem for the planter to think of before any attempt is made to fertilize the crop. It should be borne in mind also when applying the fertilizer that it should be placed where the root hairs are located. And in the case of coffee plants the root hairs are

mostly located at the growing points of the lateral roots, which roots extend as far as the branches spread.

Various fertilizer mixtures have been reported to have given good results for coffee. In India, for instance, the following mixtures are used with excellent effect on average coffee soil per acre:

Mixture	Amount	N	P_2O_5	K_2O
	Kilos	*Kilos*	*Kilos*	*Kilos*
Nitrate of soda	124.73	18.82		
Superphosphate	63.50		26.98	
Muriate of potash	45.35			22.67
Total	233.58	18.82	26.98	22.67
Nitrate of soda	63.5	9.97		
Fish guano	117.93	8.16	9.07	
Muriate of potash	45.35			22.68
Total	226.78	18.13	9.07	22.68

These mixtures should be slightly forked into the soil soon after the harvest or in two applications,—one just after the harvest and the other six months later.

In Guatemala the following mixtures are reported to have given good results:

Mixture	Rate per tree	Yield per tree
	Grams	*Grams*
Control		464.94
Double superphosphate	68.04	
Potassium sulphate	164.43	623.70
Ammonium sulphate	263.66	
Double superphosphate	68.04	
Ammonium sulphate	263.66	878.86
Muriate of potash	164.43	
One-half of—		
Superphosphate	119.07	
Potassium sulphate	82.22	
Ammonium sulphate	68.04	1,315.45
Animal dung		
One-half of—		
Superphosphate	32.02	
Potassium sulphate	82.22	
Ammonium sulphate	130.41	1,349.47
Animal manure		

In Hawaii coffee as a general rule is planted for from 3 to 4 years without fertilizer. After this period a certain mixture of artificial fertilizer is applied at the rate of about 280 kilos per hectare twice a year or 560 kilos per year.

Other authors reported that the following mixtures have given good results:

1. For the first four years, 0.113 kilo per tree of a fertilizer mixture containing 5 per cent N, 10 per cent K_2O, and 6 per

cent P_2O_5. For the 5th to 8th years, 0.907 kilo per tree of a fertilizer containing 4 per cent N, 10 per cent K_2O, and 7 per cent P_2O_5, and for the 8th or over 0.907 kilo per tree containing 4 per cent N, 10 per cent K_2O, and 8 per cent P_2O_5.

2. For every 100 trees:

(*a*)	Kilos
Nitrate of soda	39.916
Basic slag	39.916
Muriate of potash	29.937
Total	109.769

(*b*)	
Nitrate of soda	12.707
Superphosphate	22.679
Muriate of potash	9.979
Total	45.365

From the fertilizer test conducted at the Lamao Experiment Station, Lamao, Bataan, during the year 1924 on the Excelsa coffee, the following yields for three consecutive years after the application of the fertilizers were obtained:

No.	Fertilizer mixture	Rate per tree	Method of application	Yield of clean coffee per tree 1924-1925	1925-1926	1926-1927	Average
		Grams		*Kilos*	*Kilos*	*Kilos*	*Kilos*
1	Dried blood	750	B				
	Potassium sulphate	600		1.984	1.575		1.784
	Acid phosphate	1,500					
2	Dried blood	500	B				
	Potassium sulphate	400		0.560			0.560
	Acid phosphate	1,000					
3	Dried blood	500	B				
	Potassium sulphate	200			0.175	0.090	0.132
	Acid phosphate	500					
4	Ammonium sulphate	450					
	Potassium sulphate	600	B	0.312	1.225	0.500	0.679
	Acid phosphate	1,500					
5	Dried blood	750	B				
	Potassium sulphate	720		0.200			0.200
	Acid phosphate	2,250					
6	Dried blood	500	B				
	Potassium sulphate	480		2.000	0.700		1.350
	Acid phosphate	1,500					
7	Dried blood	250	B				
	Potassium sulphate	240		0.920	0.350	0.250	0.506
	Acid phosphate	750					
8	Ammonium sulphate	450	B				
	Potassium sulphate	720		0.592	2.800		1.696
	Acid phosphate	1,500					
9	Ammonium sulphate	190	B				
	Potassium sulphate	180		0.256			0.256
	Acid phosphate	450					

NOTE.—B stands for broadcasted fertilizers.

No.	Fertilizer mixture	Rate per tree	Method of application	Yield of clean coffee per tree 1924-1925	1925-1926	1926-1927	Average
		Grams		Kilos	Kilos	Kilos	Kilos
	Copra meal	2,720	B	3.672	5.425	0.800	3.299
10	.....do	2,720	H	0.480	0.350	2.000	0.943
	.....do	2,720	T	....	....	3.750	3.750
	Dried blood	327	B				
	Superphosphate	540	....	0.440	5.337	0.800	2.192
11	Potassium sulphate	1,820	....	....	....	....	....
	.....do	1,832	H	0.562	1.837	2.860	1.753
	.....do	1,832	T	0.652	0.525	1.920	1.032
	Ammonium sulphate	190	B				
	Superphosphate	54	....	2.600	4.025	0.750	2.458
12	Potassium sulphate	180	....	....	....	....	....
	.....do	180	H	0.096	0.315	0.590	0.333
	.....do	180	T	3.232	0.700	0.900	1.610
	Guano	150	B				
	Potassium sulphate	240	....	2.920	2.800	0.180	1.966
13	Tankage	750	....	....	....	....	....
	.....do	750	H	1.088	3.587	2.260	2.311
	.....do	750	T	0.424	1.925	1.090	1.146
	Ammonium sulphate	150	B				
	Potassium sulphate	2[illegible]	....	0.112	1.268	2.750	1.376
14	Acid phosphate	500	....	....	....	....	....
	.....do	500	H	1.356	1.575	0.760	1.230
	.....do	500	T	0.400	1.137	0.130	0.555
	Dried blood	33	B				
	Potassium sulphate	180	....	1.468	2.275	1.050	1.598
15	Tankage	640	....	....	....	....	....
	.....do	640	H	0.448	0.175	0.350	0.324
	.....do	640	T	0.480	0.525	7.400	2.801
	Guano	390	B				
	Potassium sulphate	18	....	5.160	4.611	....	4.885
16	Bone meal	390	....	....	....	....	....
	.....do	390	H	4.288	1.540	2.360	2.729
	.....do	390	T	0.372	5.862	0.610	2.281
	Dried blood	320	B				
	Potassium sulphate	180	....	1.630	3.307	....	2.468
17	Bone meal	390	....	....	....	....	....
	.....do	390	H	1.036	1.537	0.450	1.008
	.....do	390	T	2.400	2.000	0.370	1.590
	Ammonium sulphate	190	B				
	Potassium sulphate	180	....	1.032	2.450	5.400	2.994
18	Acid phosphate	450	....	....	....	....	....
	.....do	450	H	2.152	1.977	3.250	2.459
	.....do	450	T	0.380	0.420	....	0.266
	Dried blood	330	B				
	Potassium sulphate	180	....	0.368	2.030	1.100	1.166
19	Acid phosphate	450	....	....	....	....	....
	.....do	450	H	0.720	0.787	0.140	0.549
	.....do	450	T	3.024	3.2[illegible]2	3.200	3.142
	Control	....	....	1.144	1.632	2.010	1.595

NOTE:
B stands for broadcasted fertilizers.
H stands for fertilizers applied in holes.
T stands for fertilizers applied in trenches.

These mixtures were either broadcasted or applied in holes or in trenches. Generally the former system gave the best results. Trees treated with fertilizer mixtures No. 10, 11, 13, 16, 17, 18, and 19 gave higher yields than the control trees but the highest yields were obtained from mixtures No. 16, 10, and 18.

REJUVENATION OF OLD AND UNPRODUCTIVE TREES

Manuring, cover-cropping, top-working, thinning, and planting of shade trees should be done in the rejuvenation of the improperly planted and unproductive trees.

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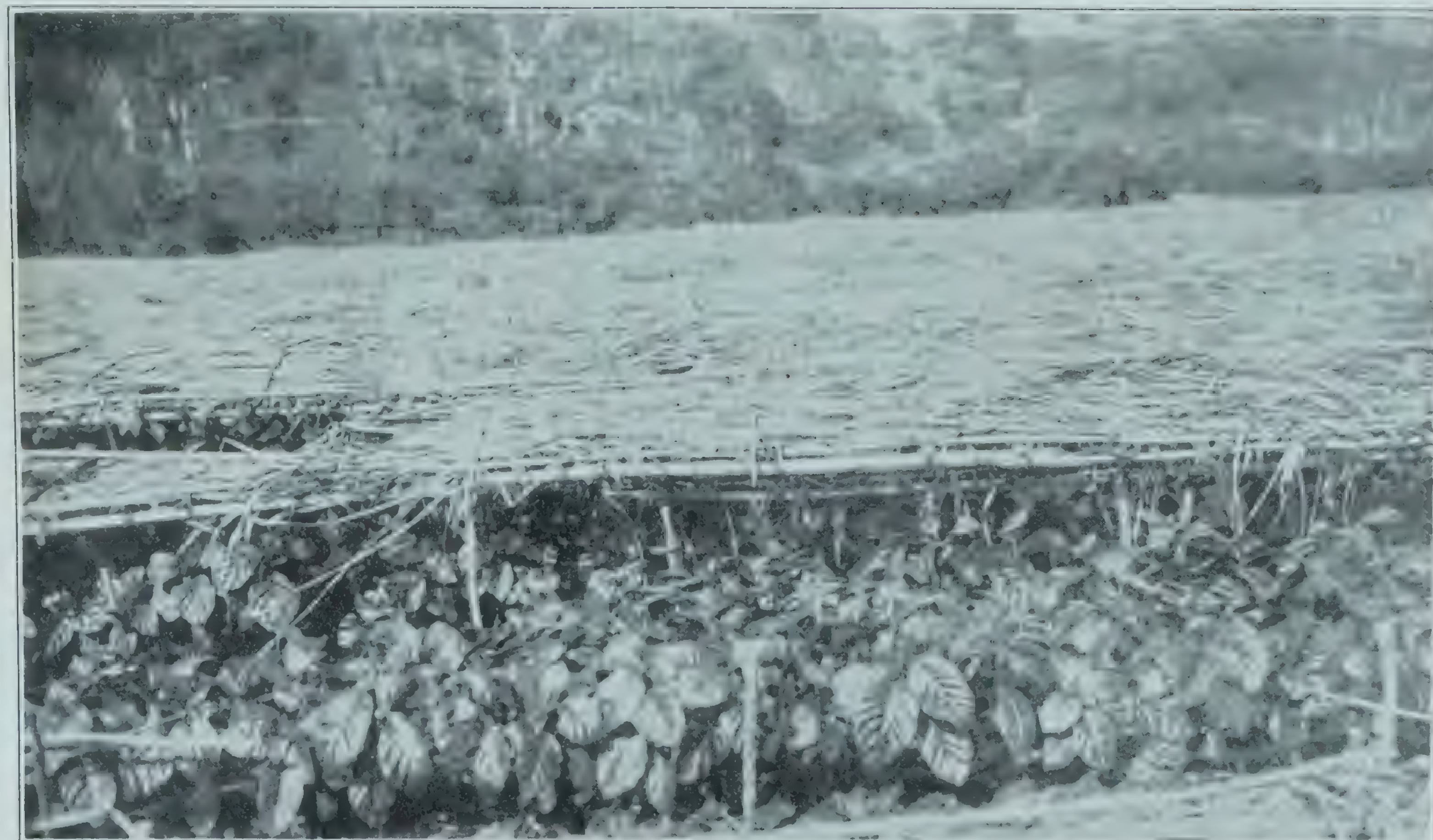
In a coffee plantation where the trees are planted either too close, without shade, in irregular rows, or sometimes with excessive shade, the coffee should first be thinned out to the proper distances according to the variety. Wherever found, the superfluous shade trees should also be thinned out, and all underbrush cut out. On the other hand, if the shade is insufficient, more should be provided, as already directed, in setting out a new plantation. And if the soil is deficient in plant foods manuring and cover-cropping should be resorted to.

Top-working.—The old as well as the young unproductive trees may be made to bear by top-working. This saves the expense of planting new ones, and the trees so treated produce a crop within a shorter time. This method is as follows:

The trees should be lopped at a height of about 25 centimeters above the ground, as are the newly budded trees in the nursery. Numerous sprouts will soon be produced from the stump. As soon as these sprouts are about 30 centimeters tall the lopped part may be entirely severed from the stump and removed. Only two out of the numerous suckers should be allowed to develop for grafting with scions taken from a known productive tree. The shoots to be selected must be growing on opposite sides of the cut trunk. In cutting off the extra twigs no stubs should be left in order that the cuts may heal quickly instead of decaying and in order that the growth of numerous wild or water sprouts may be prevented. When the two newly grafted branches are well under way cut off the poorest and leave only one to develop into a tree. The operation of lopping may well be performed during the active growth of the plant, which takes place usually at the beginning of the rainy period. During this time there is little chance for the decay of the cut trunk, which if cut during the rainy season becomes a breeding place for insects and fungi. In cutting the trunk a clean cut should always be made, and the exposed part should be painted with white lead or coal tar.

Budding or grafting the top-worked tree is performed in the same way as on young seedling stocks in the nursery, and the necessary care should be taken subsequently to remove the wild or water sprouts, the lopped branches, etc.



Coffee nursery at the Bangelan Coffee Experiment Station, Java

Coffea congensis at the Bangelan Coffee Experiment Station, Java

A coffee sun-drying house (side view), Bangelan, Java

Coffee factory-house at the Bangelan Coffee Experiment Station, Java

DISEASES AND PESTS [1]

The diseases will be discussed under the following heads: (1) Root Diseases, (2) Stem Diseases, (3) Leaf Diseases, (4) Berry or Fruit Diseases, (5) Seedling Diseases, and (6) Miscellaneous.

ROOT DISEASES

Brown root-rot.—The brown root-rot, caused by *Fomes lamaoensis* Murr., frequently attacks young trees. It may be detected by the presence of soil crust and small stones around the affected roots. This crust sometimes appears on the collar of the tree above the surface of the soil and dark brown fungus threads may be discovered in it. In the advanced stage of the disease the leaves lose their color, the branches die back, and the tree may suddenly topple over in a gale, as its roots will have become decayed. A tree affected with the brown root-rot disease should be dug up, all broken pieces of roots removed and burnt and the soil exposed to sun or disinfected with fungicide. The diseased area should be isolated by digging a trench around it. All excavated soil should be thrown inside the circle.

Root-rot.—The root-rot disease, caused by *Armillaria mellea* Quel., is similar to the brown root-rot. It frequently attacks both the tap and lateral roots. It is first visible on the trunk above the ground level. The fungus mycelium may extend from the roots to the trunk and branches of the infected tree. The affected roots are damp to the touch when freshly split open. The presence of the fungus is to be detected by the whitish streak and patches of mycelia between the bark and wood. The rhizomorphs, which are black in color, are capable of traveling through the soil and of infecting whatever roots they may come in contact with.

The disease may be controlled by employing the same methods recommended for the brown root-rot disease. In addition all rhizomorphs should be removed and destroyed.

Stump-rot.—The stump-rot disease is probably caused by *Hymenochaete noxia*, the same fungus that causes the brown root-rot disease of tea and rubber. As the name indicates this disease ordinarily arises from the decaying stump of some jungle tree which has been cut down and left to rot in a coffee plantation.

[1] Prepared by Dr. N. G. Teodoro and Mr. F. Q. Otanes of the Pests Control Division.

Diseased or dead coffee brush when dug up may be found with the roots encrusted with a gritty mass of earth, small stones, and fungus growth. When this encrustation is removed the badly affected parts of the roots may be recognized by their dark brown color.

Isolation by trenching and digging out the decayed stumps and burning them is the one effective means of preventing further dissemination of the disease. Disinfecting the hole with unslaked lime and leaving it alone for about six months has been found beneficial. If the trees are not suffering badly, it will sometimes be sufficient to expose the roots, and paint them with carbolineum or creoline solution.

Root mealy-bug disease.—This root disease of coffee is probably due to the associated attack by a fungus (*Polyporus coffeae* Wakef.) and a scale insect (*Pseudococcus citri* Risso.). It is not known which of these two is the primary cause, and it is believed that neither the one nor the other is individually responsible but that the two work together. The cottony mycelium of the fungus serves as a secure inclosure or nest for the eggs of the female mealy bugs. It is not unlikely that the fungus acts as a semi–parasite and destroys the coffee roots after they have been attacked by the scale insect.

To control the disease it is advisable to give early attention to the scale insect. Usually the presence of a coating makes treatment hard if not impossible. However, the coating can be scraped off and tobacco-soap solution or lime-sulphur mixture sprayed on the diseased parts. The removal of all seriously infested roots is the most practical method of control.

Black and white-root disease.—A root disease named the black- and white-root disease according to the colors of the fungus associated with it, is caused by a soil fungus belonging to the genus *Resellinia.*

The black type, which is the most common, is characterized by the yellowing and falling of the leaves, beginning with those on the lower branches. In its early development the parts of the trunk just above the ground are covered with a thin brown coating of the fungus mycelium. This extends to the roots as brown colored strands that become black as the disease progresses. A newly killed tree may be found with the inner tissues of its bark penetrated by the fungus.

The white type is, however, rare in its occurrence. This type exhibits practically the same characteristic features as the black type, except that in the latter case the progress is very slow

and is marked by the dying only of the infected areas. The fungus is believed to be saprophytic but as the stumps furnish it an abundant supply of food materials, it becomes active and strong enough to attack the living plants.

Control measure consists of digging a ditch around the infected plant to prevent the fungus from passing from one tree to another. The ditch is cleaned out from time to time so as to permit no accumulation of vegetable matter. In severe cases the removal of the infected trees as soon as the disease manifests itself is advisable. No litter should be allowed in a plantation, as it is an ideal medium whereby the fungus can pass from one plant to another.

STEM DISEASES

Die-back.—The die-back disease of coffee sometimes causes partial or complete destruction of coffee bushes. It is characterized by the blackening of the tips of the affected twigs. They appear lifeless although in some cases they may bear a pair of apical leaves. Often the twigs affected are entirely defoliated, and then the twigs die back and later become black and brittle.

Several species of fungi are suspected of causing the trouble, among those of prime importance being *Colletotrichum coffeanum, Fusarium coffeicola, Phoma,* and *Fusarium* found associated with the infected twigs. It is not known which of these fungi is the primary cause of the disease. Some attribute it to the *Hemileia* fungus, while others think it due to physiological troubles, such as overbearing and the presence of conditions inimical to the welfare of the plants. The disease is more prevalent in stony and eroded hilly or hummocky plantations.

Careful selection of seeds from disease-free stock and good culture, including the eradication of noxious weeds and undesirable shade, and proper pruning to prevent overbearing, constitute effective methods of control. Where the disease prevails on stony and eroded slopes, contour canals or catchpits should be dug to prevent erosion of the surface soil.

Pink disease.—The pink disease, caused by *Corticium salmonicolor* B. *et* Br., injures coffee plants considerably. It affects mostly the small branches and twigs but often occurs on the main branches. The leaves are sometimes affected also. The most conspicuous symptom is the appearance of a pink-colored coating on the affected branches. The pink layer is extremely thin, and when old, splits everywhere in lines more or less at

right angles to one another. The growth continues rapidly during the rainy season, killing the bark and peeling it off in large patches, thus exposing the wood.

In the early stage of the disease scraping off the fungus mycelia (the pink layers) and painting with lime-sulphur or Bordeaux paste is an effective method of control. In severe cases the affected branch or branches should be cut off and burned to prevent further dissemination of the disease. The wounds thus produced should be sealed with hot asphaltum to prevent infection.

LEAF DISEASES

Coffee rust.—The coffee rust, caused by *Hemileia vastatrix* B. *et* Br., is mostly confined to the leaves of coffee, but sometimes it occurs on fruits and perhaps near the tips of the young branches and causes die-back. In its early stages coffee rust appears as small yellowish spots about a millimeter or two in diameter on the under surface of the leaves. As the disease develops the color deepens to orange color.

The colored powdery substance is composed of fungus spores. In advanced stages of the disease the same spots become visible on the upper surface of the leaves. Usually plants of all ages are affected, and in severe infection the plants may be entirely defoliated.

The disease may be controlled by collecting and burning all the infected leaves and berries, and cutting off and burning the infected twigs and branches. Spraying with Bordeaux mixture is also recommended. In starting a new plantation, Excelsa, Robusta and Liberica, which have been found resistant to the disease, should be planted.

Brown-eye-spot disease.—The brown-eye-spot disease, caused by *Cercospora coffeicola* B. *et* Cke., occurs both on the leaves and berries. On the leaves it appears as small circular spots, measuring from one-eighth to one-half inch in diameter. In the early stage of infection the spots are bright in color. As the disease develops the center of the lesions become greyish-white or yellowish-brown in color, with a diffused margin. The lesions are very distinct on the upper surface of the leaves, but fructification of the fungus takes place on both surfaces of the affected leaves.

Collecting the infected leaves and berries and destroying them completely by burning will usually check further dissemination of the disease but in severe cases spraying with Bordeaux mixture is advisable.

Koleroga leaf-spot.—The Koleroga leaf-spot disease (caused by *Corticium koleroga* (Cke.) v. Hoeh.—*Pellicularia koleroga* Cke.) appears as a fine, smooth, membranous, greyish-white film covering the surface of the affected leaves. This membrane is somewhat brittle when dry, but flexible and easily peeled off when wet. It can be traced as a narrow band down the petiole and along the branches, sometimes covering a considerable distance. Its tendency is to spread toward the tips of the branches.

Good cultural practices and collecting the infected leaves and burning them and spraying with Bordeaux mixture are effective methods of control.

Leaf-spot.—Leaf-spot, caused by *Stilbella flavida*, is characterized by the presence of small circular spots that vary in shape as they increase in size on account of the obstruction of the veins. These spots are usually some six millimeters in diameter at first but invariably grow larger as the disease advances. Often two or more spots may fuse together giving entrance to other destroying fungi that infect the intervening tissues and produce spots of considerable size. On the lower and upper surfaces of the lesion on the affected leaves are produced several hair-like excrescences each bearing a head like a tiny pin. These are the fruiting bodies of the fungus and are produced continuously under favorable weather conditions. Sometimes the fungus (*Stilbella flavida*) also attacks the young trees and berries. It occurs most frequently in long-continued humid weather.

To check the development of the fungus excess shade trees should be removed to give aëration in the plantation. All infected twigs, leaves, and berries should be collected and burnt up. Under favorable weather conditions, spraying with Bordeaux mixture is recommended.

Other leaf-spot diseases.—Among the other leaf-spot diseases may be mentioned those caused by *Mycosphaerella coffeicola* and *Micropeltis mucosa*. The former produces lesions that appear as small, roundish, and greyish-white spots surrounded by deep narrow bands, while the latter produces minute, scale-like spots, that are present on both sides of the leaves. Both diseases cause little or no damage, however, and can be prevented by strict sanitary measures.

Brown blight.—The brown blight disease of berries, caused by *Colletotrichum coffeanum* Nk., also attacks the leaves, appearing as small, irregular brown spots on the edges. As the disease progresses the lesions become grey and produce small black,

pin point-like bodies. These bear the fruiting bodies of the fungus which give rise to myriads of spores.

Good cultural practices and moderate shade will at least prevent the disease from becoming severe.

Cobweb disease.—The cobweb disease, caused by a fungus possessing sterile mycelia, affects the twigs and leaves of old coffee bushes. The fungus mycelium forms thick, white branching strands, which anastomose on the under surface of the leaves into a fine, cobweb-like layer—hence its name. The fungus growth can be easily peeled off when wet. The affected leaves lose their color, become flaccid, and fall off. The disease occurs frequently only in damp places and in heavily shaded plantations.

Modern methods of cultivation and the elimination of too much shade are the best methods of control.

BERRY DISEASES

Berry blotch.—The berry blotch disease, caused by *Cercospora coffeicola* B. *et* Cke., affects the skin and pulp of the berries. The fungus infects the inner tissues of the beans causing the skin to adhere to them and making them break with the pulp during the pulping operation, and consequently produce a "low-grade" coffee. The presence of the fungus is not apparent until the berries begin to turn red when ripening. In some cases the fungus does not interfere with the normal development of the berries. However, once the berries are affected they shrivel and blacken, and insects and saprophytic fungi, such as mold, etc., destroy them completely.

Persistent spraying with Bordeaux mixture as often as the weather conditions permit will check the disease. In continuously damp weather, when the development of the fungus is hastened, the frequent application of the fungicide is necessary.

In case of slight attack collecting and burning of all infected berries should be done to prevent further dissemination of the disease.

Brown or berry blight.—The brown or berry blight disease, caused by *Colletotrichum coffeanum* Nk., which is serious on coffee leaves, does little damage to the berries. The disease appears as oval or circular-shaped spots, edged by a light brown ring slightly sunk below the level of the rest of the skin. The fungus does not penetrate the inner tissues as in the case of berry blotch disease.

Spraying with Bordeaux mixture and maintaining sanitary conditions will serve as effective control measures.

Defective beans.—The defective beans known as "lights" or "floaters" are undoubtedly due to the associated effect of the attack of various diseases affecting coffee bushes. Among those referred to the *Hemileia* leaf spot, the prevalence of die-back, *Colletotrichum* blight, *Cercospora* blotch, and berry blight cause the discoloration of defective beans. The attacks of insects such as the berry borer and variegated bugs are responsible to a great degree for the production of defective beans. Climatic conditions during the ripening of the crop contribute to a great extent to the production of defective beans. Conditions should be made to suit the requirements of the bearing trees. Then employing the control measures recommended for the diseases mentioned will minimize the production of defective beans.

SEEDLING DISEASES

Damping-off.—The damping-off disease of seedlings is caused by various common soil fungi such as *Rhizoctonia* and *Sclerotium*. Both these occur frequently on seedlings grown in unsterilized and in poorly aërated soil. The disease is recognized by the blackening of the stem of the seedlings above the ground. The discolored lesions later shrink and fall off. Oftentimes the infection spreads to the leaves, developing a black rot. The infection becomes severe during the rainy season on seedlings in damp places.

Growing seedlings in sterilized, well-aërated soil will prevent this. Infected seedlings in the seed-bed should be removed and destroyed as soon as the disease manifests itself. The seedbeds should be exposed to sunlight for at least some part of the day to prevent dampness of the bed, as this favors the rapid development of the disease.

MISCELLANEOUS

Witches' broom.—Witches' broom occurs frequently as a close mass of hypertrophied shoots of primary and secondary branches. It is sometimes caused by insect injury, and sometimes by fungus attacks. Removing the branches and twigs bearing witches' broom and burning them will prevent its further development.

Loranthus stem parasite.—The most common parasite of the stem and branches of coffee is a flowering plant botanically known as *Loranthus*. This kills the branches on which it grows and in time kills the whole plant. The *Loranthus* bears flowers and fruits and so spreads from tree to tree. The leaves of the

parasite differ to a great extent from the leaves of the host plant, hence it can be easily detected even before the flowering season.

Removing the branches bearing the parasite as soon as they are discovered and burning them all is the most economical and effective method of control.

Sooty mould.—The sooty mould caused by *Capnodium brasiliensis* Put. which affects the leaves sometimes affects the stems and branches also. The disease forms a coating on the surface of the leaves. The fungus, however, is not parasitic in its nature but it interferes with the photosynthetic activities of the leaves. Its presence is an indication of the presence of some destructive agents such as scale insects and mealy bugs. The fungus lives upon the "honey dew" excreted by these insects.

Spraying with a kerosene emulsion or a tobacco decoction is recommended for its control. This is to kill the insects, but the sooty mould fungus will disappear after the insects are destroyed or driven away by the spray solution.

As in the case of other important crops, no systematic and prolonged studies have been made of the insect pests, as well as other enemies of coffee. Nevertheless, it has been considered advisable to prepare the following brief account of the most important pests attacking the coffee plant, with recommendations and suggestions as to methods of control, for the benefit of planters as well as others who are interested.

INSECTS ATTACKING THE ROOTS

Grubs.—The larvae or grubs of the "toy-beetle" (*Leucopholis irrorata*) have been observed to attack the roots of coffee seedlings in nurseries. When abundant they may kill a considerable number of the young plants. The grubs can be controlled by digging them out or by injecting carbon bisulphide into the soil. Collecting the adult beetles as soon as they appear in May or June has proved effective.

For further information about this pest and its control, see Circular No. 166 of the Bureau of Agriculture.

INSECTS ATTACKING THE STEM, BRANCHES, AND TWIGS

There are recorded several species of different genera and families of beetles which attack the stem and branches of coffee. One of these is a tiger beetle (*Collyris albitarsis*) the larva of

which tunnels the stem. Another larva which injures coffee in the same way is that of a long-horned beetle, *Monohammus fistulator*. A third is a very tiny beetle of the family *Scolytidæ*. Both the adults and the larvæ of this last species bore into the stem and branches of coffee.

The first two species are not usually numerous. Collecting the beetles and extracting the larvæ from their tunnels may suffice to control the pest and prevent their spread in the plantation. Injecting paradichlorobenzene crystals into the tunnels of the larvæ or grubs may also be done.

The third species of beetle usually attacks weakened or old coffee plants, portions of the stems and branches of which are dead or dried up. Cutting off and burning the badly-infested branches and twigs as well as dead plants will help reduce the damage by the pest. Spraying the plants, especially the stems, with lime-sulphur or with lead or calcium arsenate may be practiced.

INSECTS ATTACKING THE TWIGS AND LEAVES

Slug caterpillar.—There is one slug caterpillar, the caterpillar of a moth, *Thosea* sp., that attacks the leaves of coffee. This caterpillar is green and armed with spines, which have an irritating effect upon the skin.

When the caterpillars are few they may be removed from the plants with bamboo forceps and crushed. When abundant they can be killed by spraying the plants with soft laundry soap solution, at the rate of one-half kilo dissolved in about 20 liters or one petroleum canful of water. To make the spray more effective lead or calcium arsenate at the rate of 2 to 5 grams per liter should be mixed with the soap solution. The mixture acts both as a contact and a stomach poison.

Bagworms.—Bagworms often become troublesome in coffee plantations. These are the caterpillars of a moth of the family *Psychidæ*. They are so called because they are protected by bags constructed by the worms themselves. When there are only a few, the worms can just be picked off the plants, but when abundant the plants need to be sprayed with lead or calcium arsenate at the rate of 2 to 5 grams per liter of water. It is best if soap solution is used together with the lead arsenate as the soap serves as a sticker.

Aphids or plant lice.—Aphids or plant lice are sometimes found attacking coffee. These insects suck the juices of the plants.

These may be killed by means of soap solution (one-half kilo of soft yellow soap, Chinese soap, for example) or kerosene emulsion. The latter is prepared according to the following formula:

Kerosene	8 liters
Soap	0.3 kilo
Water	4 liters

The soap is cut into bits and dissolved in the water by boiling. Thereafter the container is withdrawn from the fire and the kerosene is added little by little the solution being vigorously churned at the same time. This is best done by pumping the liquid back into the container with a bucket pump until a white creamy solution is obtained. This is the stock solution. For spraying one part of the stock solution is usually diluted with 16 parts of water.

After the complete fertilization of the flowers, especially when the coffee tree is dry, it should be shaken once in a while or every time the wild sprouts are removed to avoid the attack of aphids and plant lice.

Scale insects.—There are several species of scale insects that attack the leaves as well as the twigs of coffee. Like aphids, these insects suck the juices of the plants and inflict some direct injury. The most important of these is the green or coffee scale (*Coccus viridis*) or (*Lecanium viridis*) which has done considerable damage to some coffee plantations in Rizal, and the mealy bugs, there being at least two kinds, *Pseudococcus filamentosus* and *P. virgatus*. The hemispherical scale (*Saissetia hemisphaerica*) and the black scale (*Saissetia oleæ*) are also said to attack coffee.

Soap solution, at the rate of one-half kilo dissolved in 20 liters of water, is a good spray for all of these scales. Nicotine sulphate, if available, is one of the best.

Thrips.—Thrips are sometimes found troublesome. These are also small insects and like scales they suck the juices of the plants. These can also be destroyed by the use of soap solution or by means of nicotine sulphate.

Mites.—Mites or red spiders become especially troublesome during the dry season. Soap solution or lime-sulphur spray is good for these pests. Nicotine sulphate may also be used.

Wild cats and monkeys often damage the crop.

PESTS OF COFFEE IN OTHER COUNTRIES NOT KNOWN TO BE PRESENT IN THE PHILIPPINES

There are a considerable number of coffee pests in other countries not as yet found here and these should be kept out. One

of these is the coffee berry-borer, *Stephanoderes hampei* Ferr. (= *Stephanoderes coffeæ* Hagen). As its name indicates it bores into the berries as well as the dried seeds and can thus be easily introduced. The insect is a small beetle and is from one to two millimeters long. It lays its eggs in the berries and these eggs hatch into larvæ or grubs which feed within the berries. The insect is reported to be bad in Java, Brazil, and in certain other coffee-growing countries. The insect can probably be kept out by restricting or prohibiting the importation of coffee berries from infested countries.

One of the measures used in other countries against the pest is fumigating the seeds with turpentine and carbon dioxide.

The coffee borer is another destructive pest and it has been responsible for the loss of many coffee trees in India.

The so-called shot-hole-borer (*Zerozera coffeæ*) is another enemy, but as it is not found on the seeds, it can be excluded successfully by prohibiting the importation of all shoots upon which the butterflies lay their eggs.

Microscopic nematode worms are reported to be doing much damage to the roots of the Arabian coffee but not to the Liberian and the Excelsa varieties.

The beetle, *Xyleborus coffeæ,* is reported to be a dangerous pest of coffee.

HARVESTING AND YIELD

The method of harvesting coffee in the Philippines is very primitive. The berries are picked one by one, by either men, women or children. When the branches are high, as no topping is practised, the harvester pulls them down and holds them with his feet so that both hands are free to pick the berries, or else they are held down by ropes. Sometimes ladders are used in harvesting low-branched coffee. Picking the berries from the nodes is done very roughly, no precautions being taken not to injure the nodes, which parts are the permanent fruiting places of the coffee plant. Needless to say this method of picking coffee berries should not be used. In some localities the berries, irrespective of their degree of ripeness, are all harvested at the same time while in other places only ripe berries are picked.

This of course is the proper method to get a clean and uniform product that will bring a good price. By uniform here is meant not only the same in size but in color also. Ordinarily a coffee

tree will fruit heavily from the 5th to the 10th year. But before this some berries are produced on the trees, and among these some ripen earlier than others. So harvesting is done as soon as there are any ripe berries, especially in the case of Arabian coffee. The ripe berries of this variety drop off if not gathered at once. In pulling off the berries care should be taken not to injure the nodes by pulling the berries against their natural direction. They should always be pulled toward the outer end of the branches so as not to bruise any of the nodes bearing the berries. If this is not done the productive capacity of the plant will be lessened as it grows old. The ripe berries can be distinguished easily by their red or yellow color and sometimes by their shape.

In the Philippines, harvesting in most cases is done on a share system whereby the harvester gets from one-fourth to one-half of the crops, and in Java they pay from 2 to 5 guilder cents per kilo of fresh berries—two cents for the first harvest and five cents when there are only a few berries left on the trees.

The productive life of the coffee tree has not so far been determined. In Brazil 60-year old trees have been reported to give better yields than young ones. In Java trees 32 years old and in Hawaii from 40 to 80 years old have been reported to be producing good crops.

The yield of coffee is quite variable, much depending upon the soil and climatic conditions of the place, and the treatment accorded to the plantation. Generally speaking and under good cultural treatment the yield of Arabian coffee for the third year is about 90 kilos of clean coffee and thereafter increases to 400–800 kilos to the hectare. In Hawaii, 1,220 to 2,250 kilos of clean coffee per hectare have been recorded. In Hamakua, Hawaii, yields of from 550 to 675 kilos per hectare have been obtained from the Guatemalan variety, and in Porto Rico a yield of 355 kilos. The yield of Arabian coffee in the Philippines has ranged from 0.55 to 1.00 kilo per tree for the last 13 years or an average of 0.77 kilo of clean coffee per tree. At this rate if 1,333 trees were planted to the hectare the yield would be 1,026 kilos per hectare.

The Robusta type when in full bearing produces from 800 to 1,000 kilos of clean coffee per hectare while the yield of the Liberian type varies from 500 to 700 kilos, now and then exceeding the latter figure. At the St. Clair Experiment Station, Excelsa coffee 10 to 11 years old yielded 4.09 kilos per tree. At the Lamao Experiment Station, Lamao, Bataan, the yields ob-

tained from the different varieties of the Liberian type are as follows:

Coffee yields at the Lamao Experiment Station

Variety	Year planted	Average yield per tree of clean coffee				
		1919	1920	1921	1922	1923
		Kilos	*Kilos*	*Kilos*	*Kilos*	*Kilos*
Liberian	1917	....	....	....	0.513	0.638
Excelsa	1916	0.128	0.147	0.871	1.409	1.132
Dybowskii	1919	....	....	....	....	0.192
Excelsa	1917	....	....	....	....	0.132
Liberian	1917					
Abeocuta	1917					....

Variety	Year planted	Average yield per tree of clean coffee				
		1924	1925	1926	1927	Average
		Kilos	*Kilos*	*Kilos*	*Kilos*	*Kilos*
Liberian	1917	1.557	1.376	2.164	1.022	1.212
Excelsa	1916	1.519	1.329	1.815	1.390	1.082
Dybowskii	1919	0.119	0.435	1.136	0.314	0.439
Excelsa	1917	0.792	0.438	0.981	1.422	0.753
Liberian	1917	0.889	0.951	1.558	0.580	0.995
Abeocuta	1917	....	0.472	0.907	0.107	0.495

The land where the Excelsa, Liberian, and Abeocuta coffee trees were planted in the year 1917 was and still is rather poorly drained and as a result low yields have been obtained from all the varieties except the Liberian in field "E" which has given an average yield of 1.212 kilos of clean coffee per tree, but trees of this variety are planted on as good soil as that on which Excelsa was set out in 1916.

The yields of the various coffee varieties planted in 1916, with the exception of the Abeocuta, which was planted in 1917 at La Carlota Experiment Station, La Carlota, Occidental Negros, are as follows:

Coffee yields at La Carlota Experiment Station

Variety	Distance	Yield per tree of clean coffee in nine years						Computed yield per hectare
		1918 to 1921	1922	1923	1924	1925 to 1926	Total	
	Meters	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*	*Kilos*
Abeocuta	3.5	15.20	101.40	24.30	11.90	283.00	435.80	59.27
5466-Canephora	2.7	47.97	62.10	47.70	14.70	844.40	1,016.87	154.78
5467-Canephora	2.7	103.10	85.70	98.10	55.20	218.70	560.80	85.36
5388-Congo	2.7	....	38.10	....	....	....	30.10	52.20
5468 Congo	2.7	....	2.70	....	....	....	2.70	3.70
5389-Excelsa	4.0	8.20	109.00	....	....	202.90	320.10	50.01
5369-Excelsa	4.0	4.00	499.10	....	....	410.70	913.80	142.78
Robusta	2.7	43.04	358.00	....	310.00	23.70	734.74	143.80
5454-Robusta	2.7	5.60	22.70	....	....	191.10	219.40	75.14
5460-Robusta	2.7	48.61	41.70	27.70	....	372.90	490.91	84.06
5461-Robusta	2.7	18.30	21.50	84.10	24.30	114.90	263.10	40.05
5463 Robusta	2.7	25.30	64.10	....	....	37.80	127.20	24.89
5464-Robusta	2.7	8.14	43.50	....	....	164.00	215.64	59.09
5287-Quillou	3.0	16.00	248.30	2 8.90	....	302.50	775.70	172.36
5465-Quillou	3.0	31.50	182.30	122.30	....	355.60	691.70	109.78
5470-Uganda	2.7	29.79	23.20	23.10	....	1,350.00	1.426.09	244.22
5471-Uganda	2.7	59.50	81.30	112.80	53.60	472.70	779.90	133.52

The average yields of the Robusta coffee as reported in 1923 at various places in Lipa, Batangas, are as follows:

Yields of Robusta coffee at Lipa, Batangas

Year planted	Distance	Yield per tree of clean coffee	Computed yield per hectare	Shade
	Meters	*Grams*	*Kilos*	
1909	3 × 3.5	525	499.80	Anae and madre-cacao.
1914	3 × 4	450	374.85	Madre-cacao.
1915	4 × 4	53	33.13	Anae and madre-cacao.
1916	3 × 3	98	108.88	Madre-cacao and bananas.
1917	3 × 3	1,500	1,666.50	Do.
1919	4 × 4	90	56.25	Anae.
Average	......	453	456.57	

PREPARATION

Coffee berries have a reddish outside husk, called the *pulp*, within which is an envelope of gelatinous matter resembling glucose, called the *slime*, that surrounds a tough, parchment-like *hull*, which loosely covers the pellicule, or *silverskin*, which, in turn, is more or less closely adherent to the true coffee bean. The four envelopes must all be removed completely from the bean as rapidly as possible to obtain a first-class marketable coffee. If the slime is left on after husking, the drying process is likely to be retarded and an inferior article produced. Coffee keeps best in bags with the pulp and slime removed, and the dried hull left on, but the market demands that the silverskin and the hull must always be removed before first-class coffees are shipped. The berries of the different varieties vary in size and the relative ease with which these envelopes can be removed, and the prices and grades are affected by the way in which their removal is accomplished. The preparation of the coffee berries on a large scale before they are marketed is as follows:

At first the freshly picked berries are weighed as they are brought to the mill, for the purpose of paying the pickers. Then the leaves, stones, dirt, and other impurities mixed with the berries while picking are removed by passing them through a revolving drum about 1.5 meters long and 1.2 meters in diameter, made of large meshed screen with a worm of galvanized iron, the flange being 25 centimeters wide and fitted to the mesh on the inside to carry out the dirt, and the mesh being large enough to allow the berries to fall through as the drum revolves. They are next washed in channels filled with water then brought to the pulping machine.

Pulping.—This process will free the berries from the husks, which are removed, and the pulped coffee falls into the ferment-

ing vats usually made of wood or cement and placed directly below the pulper, where they remain to ferment. Berries picked in the morning should be pulped in the afternoon and if pulping is delayed it becomes harder to remove the pulp. If possible the berries should be pulped as soon as they are removed from the trees. The fermentation vats are provided with a vent in the bottom through which the coffee is flushed to a revolving washer. The ordinary pulping machine is a cylinder covered with blunt projections. For every type of coffee a different pulping machine is required, because the present machines are not adjustable to suit the size of the berries of each of the types of coffee. The price of a pulper for small sized berries is about ₱320 and for the larger ones ₱200.

The red flesh and husks are sometimes pressed with weights to remove the water, moulded with the feet into briquettes, and used after sundrying, as fuel with the hulls and dust.

Fermentation and washing.—The slimy substance under the husk is usually removed by some process of washing after fermentation. During the process of washing the pulp from the beans and the remaining skins that have escaped from the pulper may also be removed.

In the dry fermentation process, the pulped berries are left in heaps to ferment for two or three days. And in wet fermentation it is necessary to keep the berries entirely under water in vats for two or several days, the time depending on the altitude, temperature, and climate.

The slimy substance is easily removed after fermentating the beans by a washing process carried on by men who, with large wooden hoes, rub the berries back and forth in the water-filled vats.

The great objection to both these methods of fermentation is that "stink coffee" is often produced by a butyric acid putrefaction, which gives an inferior product. This can be prevented by care and experience, but it must always be watched for, and skilled superintendence is required in order not to ferment the beans too long.

On coming out of the revolving washer the mass falls on a perforated shaker through which is carried away most of the slime and refuse with the water, the coffee dropping into the lower end of a trough about 3.5 meters long, tilted upward at an angle of about 30° containing a revolving worm carrier about 30 centimeters in diameter. As the coffee is being carried upwards in the trough by the screw it is met by a stream of clean

water which rinses it and overflows at the top of the lower end of the trough, carrying with it all "floaters," or light, imperfect beans, which are thus separated and later made into a cheap grade coffee. After passing through the rinsing trough the coffee falls on another shaker for the removal of the few remaining impurities and water, and from there it goes to a chain conveyor which carries it to the drying floor.

A new washing process has been invented by which the berries pass directly from the pulper to a "French" washing machine which removes the slime quickly, and without fermentation, by the friction produced by the two shafts provided with vanes, revolving in opposite directions under water, thus saving time, labor, expense, and the risk of putrefaction. Some ashes, or 600 grams of sifted slaked lime to 4 piculs of wet coffee berries, are usually placed in the machine to hasten the process, which was originally introduced because it was difficult to handle the Robusta berries satisfactorily by wet fermentation.

The machine is especially useful where there is a large harvest and a small supply of water, and the coffee it produces sells at a higher price.

Drying.—After the washing process has been completed, the berries are drained on a galvanized iron plate, perforated with circular holes, and then dried as quickly as possible. But in order to command a good price in the world market, the Robusta and the Liberian types require artificial drying in especially constructed dryers, which because of their cost can not be erected by small individual growers. These drying houses are usually plastered brick buildings with galvanized iron roofs, well ventilated by a space between the tops of the walls and the roofs. At about half of their height, there are floors of galvanized iron plates pierced with circular holes, below which are a number of iron pipes about 18 inches in diameter, through which the smoke and gases from the furnace at one end pass to a heater connecting with the chimney at the other end.

The drying house as shown elsewhere in this article has two drying compartments each consisting of 18 pieces of iron plates for flooring, measured 3 by 6 feet. Each of the compartments has a capacity of two piculs of fresh berries and double when half dried. The fresh berries are first dried in the first compartment and when half dried are transferred to the second one for final drying.

The coffee berries are spread on the floor of the drying house and the fire kept on burning for two or three days or until

the berries are perfectly dried in a temperature of 100° C. for the first 12 to 13 hours, then reduced to 60–70° C. for a similar period, if necessary, after the quantity of berries in the drying house has been doubled.

On many plantations the berries are first sun-dried on a concrete, or plastered brick platform, protected from rain by pieces of roofs, which slide away on wheels or rollers, resting on rails, to expose the berries to the sun. When rain threatens the sliding roofs are pulled over the drying floor on rails overhead by means of cables wound on a drum. Both rails and the drying floor are constructed slightly inclined to one side, so that when it is desired to again uncover the coffee the cover rolls away by gravity merely by releasing a catch attached to the drum on which the cable is wound. Part of the drying floor is covered by canvas thrown over a ridge pole during rainy weather. After a preliminary drying for three or four days on the floor, the drying of the coffee is completed in a hot air drier as described above, after which the coffee is hulled, graded, and sacked ready for shipment.

Hulling.—It is best to hull the coffee as soon as it becomes glass-hard or dried perfectly. The silverskin of practically all varieties is readily removed by the huller, but if the beans are moist, it can only be done with difficulty. In such cases, it is necessary to dry them again, or, if this is not sufficient, put them in bags, steep them in boiling water for a few seconds to expand the silverskin, and then spread them out first to air-dry or put them at once into the drying house. In any case they are put again through the huller after drying. In the hulling machine, revolving cylinders, or worn wheels with vanes, tear off the hull, remove the silverskin, and polish the beans. When it is working well, there should be no broken beans, and if there are any, the machine should be readjusted. Broken, black, and imperfect beans are usually removed by hand picking. The rice huller can be used for this purpose although a coffee huller is preferable in case it is obtainable. The huller is always run by a power engine. To remove all traces of silverskin sometimes it is necessary to pass the beans twice or three times through the huller.

The hulls and silverskin are usually removed with a fan—a fanning apparatus with pipe attached to the huller—and the beans then sorted to size by passing them through a long, revolving cylinder slightly inclined and perforated with holes of various sizes.

The removal of the silverskin is one of the main problems of the coffee industry. Its presence does not in the least affect the flavor or quality of the beans, but only their appearance. The silverskin is removed while roasting the beans, and with the aid of the exhaust fan in the coffee mill, and by winnowing or sifting, when roasted in the home. This is, however, of great importance, as upon it the price largely depends. Berries with the silverskin still wholly or partly adherent usually sell at a lower price, and sometimes will not sell at all, when there is an oversupply. For this reason, the establishment of large plantations is not advisable unless modern machinery is installed for this purpose.

Native preparation.—In the Philippines coffee berries are usually dried in the sun. In Java many planters still prepare coffee by this system. This method of preparing coffee is carried on in three different ways as follows:

1. The ripe berries with husks on are dried in the sun and the native planter removes the dried husks, pulp, slime, hull, and part of the silverskin by handmills or mortars and pestles or with the aid of a rice mill. This system of removing the silverskin can easily be managed with Arabian coffee but with the other kinds of coffee, like the Liberian and the Robusta types, the removal of the silverskin by the native process is rather difficult. Pulping the fresh berries is now being facilitated by the use of a wooden roller as devised at the Lamao Experiment Station, Lamao, Bataan.

2. The berries are first fermented for 24 hours and after that they are washed and dried in the sun until the inner skin separates readily when crushed or pounded in a wooden mortar. This method of drying requires much labor especially in the rainy season. It takes from 30 to 50 days and still there is much loss by decaying.

3. In preparing coffee on a small scale the red coating is peeled off and then the berries are carefully washed. After this they are dried in the sun for 4 or 5 days or until they are ready to be crushed. When dried they are spread on flat boards, and a small wooden roller is rolled over them, thus breaking the second coating or tegmen.

In Brazil, coffee is prepared in two ways, namely, by the dry and the wet systems. The dry method consists of spreading the berries in the sun and protecting them from rains and, when they are dried, storing them in dry places and separating the pulp. By the wet method, the berries are submerged in

a tank of water for several days; then the pulp is removed by trampling and dried afterwards.

If the berries of the Liberian and the Robusta types are prepared by the native system, after they are sun-dried the silverskin can be removed by moistening the beans and redrying them, then passing them through a hand rice mill or other suitable machine, and if still all the silverksin is not removed the operation is to be repeated a second or third time. For if this is not done, the silverskin of the sun-dried berries is very difficult to remove not being loose as in the case of the hot air-dried berries, where quick drying is done.

Immatured and diseased berries should be prepared separately from the good ones so that the latter will not lower their market value. At the Bangelan Coffee Experiment Station, Malang, Java the berries attacked by the beetles are picked separately and put in boiling water for one half to one hour to kill the insects, and then sun-dried before they are finally dried in the drying house, after which they are pulped.

COST OF PLANTING COFFEE

The cost of planting a hectare of coffee land is variable, depending as it does upon the locality, land, type of soil, labor, wages, management, etc. However, for the guidance of the coffee planters an estimate of the expenditure necessary to plant and maintain a hectare of coffee land during the first year may be itemized as follows:

Item	Open	Jungle
Preparation of the land:		
Clearing, stumping and burning	....	₱100.00–200.00
Plowing (two or three times)	₱20.00– 30.00	....
Harrowing (two or three times)	6.00– 8.00	....
Furrowing for the cover crops	2.00– 4.00	....
Staking, materials and labor	8.00– 10.00	8.00– 12.00
Holing for coffee plants	10.00– 12.00	10.00– 15.00
Putting decayed manure in coffee holes	5.00– 15.00	....
Planting:		
Permanent shade trees	4.00– 8.00	4.00– 8.00
Temporary shade trees	4.00– 8.00	4.00– 8.00
Coffee seedlings	4.00– 8.00	4.00– 8.00
Cover crops	3.00– 5.00	5.00– 10.00
Catch crops	....	5.00– 10.00
Maintenance of the plantation:		
General cultivation	6.00– 20.00	....
Hoeing	6.00– 10.00	15.00– 30.00
Replanting coffee and shade trees	5.00– 5.00	5.00– 5.00
Mulching the coffee	10.00– 15.00	10.00– 15.00
Pruning, thinning and topping:		
(a) Shade trees	1.50– 2.00	1.50– 2.00
(b) Coffee plants	1.50– 2.00	1.50– 2.00
Miscellaneous work	5.00– 5.00	5.00– 5.00
Cost of seeds:		
Shade trees	1.00– 4.00	1.00– 4.00
Coffee seedlings	19.00– 34.00	19.00– 34.00
Cover crops	2.50– 5.00	2.50– 5.00
Catch crops	....	1.00– 1.50
Total	₱123.50–210.00	₱201.50–384.50

The items for the maintenance of the plantation may be carried yearly except the replanting, and if the plantation is properly cover-cropped general cultivation may also be dispensed with.

According to Van Leenhoff, formerly of the Porto Rico Agricultural Experiment Station, Mayaguez, it cost as follows to bring one hectare of Arabian coffee into bearing in Porto Rico:

Clearing the land	₱54.34
Staking	10.88
Holing	87.73
Propagation of coffee seedlings in the nursery	24.70
Planting	43.86
Shade trees	7.41
Hoeing (twice)	43.86
Weeding (four times)	26.28
First year's expenditures	₱299.06
Second year's expenditures	76.77
Third year's expenditures	69.90
Total	₱445.73

Wester says that in Java on an estate where labor is obtainable at 16 to 24 centavos per day, the annual cost of upkeep per bouw (0.7 hectare) is as follows:

Machine cultivation	₱0.80
Weeding (hoeing) 6 times per year	9.60
Topping and pruning	5.20
Attention to shade trees	3.20
Clearing jungle around the plantation	0.32
Sundries	0.18
Total	₱19.28

In Porto Rico the expenditure for picking, preparation and transportation to the nearest port is ₱11 per hundred kilos of clean coffee, which is approximately the same as in Java. In the latter country when wages were 16 to 24 centavos a day, the cost of harvesting the berries, the preparation of coffee and the transportation to the nearest port was ₱10.14 per hundred kilos of clean coffee, and when the labor was 24 to 28 centavos a day, the expenditure was ₱11.34.

The over-head charges, interest, depreciation, etc., are not included in the foregoing expenditures.

A small coffee central capable of milling the product of a plantation of from 350 to 400 hectares of coffee may be con-

structed at a cost of about ₱15,000, which sum may be distributed as follows:

Machinery shed and bodega	₱3,500.00
Drying house and dryers	4,400.00
Power plant and huller	3,600.00
Fermentation vats	1,500.00
Sundries such as water plant, etc	2,000.00
Total	₱15,000.00

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COMPARISON OF THE DIFFERENT METHODS OF TAPPING PARA RUBBER

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The object of tapping is naturally to obtain the maximum production of latex with the minimum damage to the tree and at the lowest possible cost. Although various systems are in vogue in different countries, yet it is still a question which system is best adapted to the Philippines; hence this investigation. Different systems of tapping have their own advantages and disadvantages. It is fairly certain that excessive tapping is often responsible for the occurrence of brown bast disease. While the most widely employed system in Ceylon is the one cut on the half-spiral on alternate days, yet in Sumatra daily tapping on one-third of the circumference is done (1).

CLIMATE AND SOIL

The climate of Baco generally resembles that in most of the localities in the Province of Mindoro, which, according to Father Algue's (2) classification of the cimate in the Philippines, belongs to the first type. In general, the rainfall is uniformly distributed throughout the year. There is no distinct wet and dry season. The heaviest rainfall is during November, December, January, and February while the lightest is from March to June. The medium is in July, August, September, and October. Although Mindoro is within the typhoon belt, yet the rubber trees at Baco have not suffered any appreciable damage from storms.

The plantation is protected by hills on the western and northern parts from typhoons, while the eastern and southern portions are exposed to the wind. The ground is level except in the western and northern parts, where it is hilly. Most of the trees tapped in opposite V's are located in the hilly portion. But the majority are on the plain.

The soil ranges from clay loam to loam. The surface soil is quite deep and varies from brownish sandy loam to dark clay

loam. The sub–soil is clayey with pebbles in the hilly portion. The following tables show the physical and chemical analyses of the surface soil and sub-soil as reported by the Bureau of Science from the samples submitted by the Bureau of Agriculture:

TABLE I.—*Mechanical analysis (water-free basis)*

Analysis	Surface soil	Sub-soil
	Per cent	*Per cent*
Coarse sand, 1 to 0.5 millimeter	5.5	5.6
Medium, 0.5 to 0.25 millimeter	9.4	11.6
Fine, 0.25 to 0.10 millimeter	9.1	19.4
Very fine sand, 0.10 to 0.05 millimeter	23.5	21.9
Silt, 0.05 to 0.005 millimeter	40.3	30.9
Clay, 0.005 millimeter	12.2	10.6

TABLE II.—*Chemical analysis (surface soil—water–free basis)*

	Per cent
Loss on ignition	7.17
Nitrogen (N_2)	0.198
Phosphoric anhydride (P_2O_5)	0.109
Lime (CaO)	0.72
Potash (K_2O)	1.447
Humus	0.84
Soil acidity (per cent $CaCO_3$)	0.028

MATERIALS

This experiment was started in July, 1926, on about 12-year old Para rubber trees not previously tapped. The opposite V's system was lately started in January, 1927. The plantation was jungle-checked, for it had been neglected since the corporation that owned it was dissolved. The trees were planted 5½ by 5½ meters apart, but some occupy a wider space now for intervening trees have died. Many have poor bark, for their trunks have been badly mutilated by bolos. The girth measurement, taken November 9, 1927, varies from 18 to 51 inches.

METHOD

Three systems of tapping were tested namely, the half-spiral, V-shaped and opposite V's. There were two sections of 30 trees each for each of the half-spiral and V-shaped methods. One section of each of these two systems was tapped daily in the morning and the other every alternate day. The opposite V's consisted of only one section of 30 trees. Tapping was done alternately every other day.

The half-spiral and V-shaped were started in July 1926. The daily and alternate daily sections of the half-spiral system consisted previously of 44 trees each. In October 1927, the number of trees of each section was reduced to 30. The poor and non-yielding trees were passed over, for they only increased the expense of the experiment. The opposite V's system was started in January 1927, on 40 trees. But as for the half-spiral and the V-shaped systems, the number of trees was reduced to 30 on October, 1927.

Tapping was done in the early morning at 6 o'clock. Only one man was assigned to tap this whole block to prevent errors due to variation in the tappers. The yields of the individual trees were recorded. The latex was collected in glasses of almost uniform shapes and sizes so that the volume was readily measured in cubic centimeters. After the production was recorded, the latex was poured into a bucket and the glass was then washed in another bucket containing fresh water from which rubber number 2 called the cup washings is obtained.

The latex was then brought to the laboratory and all dirt and lumps of rubber strained out. Coagulation was then brought about by adding one part of the stock solution of acetic acid to 50 parts of the latex. The stock solution was prepared by mixing one part of concentrated commercial acetic acid to 20 parts of water. This proportion of acetic acid to diluted latex caused coagulation in from one to two hours. The following morning, the coagulum was first kneaded with a wooden pin roller and finally through a rubber hand roller machine to remove as much of the water as possible to facilitate its drying. Then the milled sheets were carefully washed with fresh water, air-dried, weighed and placed in the smoke house until they were dry enough to give constant weights. It took from 10 to 15 days to dry them. The wet weight of the cup washings and the tree scrap were likewise taken and dried in the smokehouse.

RESULT

The monthly production from July 1926, with the exception of that for the opposite V's system which began in January 1927, to June 1928 together with the totals and their corresponding averages are shown in Table III.

TABLE III

Months	System: Half-spiral, Daily, Latex	System: Half-spiral, Daily, Dry rubber	System: Half-spiral, Alternate daily, Latex	System: Half-spiral, Alternate daily, Dry rubber
1926	*Cu. cm.*	*Pounds*	*Cu. cm.*	*Pounds*
July	41,563	32.82	22,257	17.57
August	45,059	34.51	38,533	29.33
September	27,668	20.38	19,490	14.36
October	18,945	15.21	15,193	22.22
November	21,498	16.31	13,796	10.47
December	17,217	12.57	14,537	10.61
1927				
January	29,199	20.87	27,304	13.52
February	29,186	21.25	22,317	16.25
March	20,066	15.71	17,354	13.59
April	15,323	11.48	10,834	8.10
May	18,199	13.61	13,188	10.60
June	8,429	6.32	16,154	12.11
July	20,013	14.98	15,747	11.78
August	14,382	12.48	7,724	6.70
September	21,946	21.10	8,708	7.98
October	16,800	13.60	8,961	7.25
November	17,523	11.87	7,560	5.12
December	24,400	16.15	15,159	10.03
1928				
January	15,205	10.97	11,692	6.23
February	10,776	8.22	5,826	4.44
March	17,399	13.85	13,905	11.07
April	19,129	14.26	14,426	10.75
May	25,130	18.85	14,520	10.89
June	30,467	22.72	15,102	11.63
Total	525,522	402.09	370,787	282.60
Average	21,896	16.75	15,449	11.77

Months	System: V-shaped, Daily, Latex	System: V-shaped, Daily, Dry rubber	System: V-shaped, Alternate daily, Latex	System: V-shaped, Alternate daily, Dry rubber	System: Opposite V's, Daily, Latex	System: Opposite V's, Daily, Dry rubber
1926	*Cu. cm.*	*Pounds*	*Cu. cm.*	*Pounds*	*Cu. cm.*	*Pounds*
July	87,812	69.35	45,704	36.09	(a)	(a)
August	32,944	25.07	37,934	28.87	(a)	(a)
September	14,867	10.95	15,103	11.13	(a)	(a)
October	13,444	10.79	14,108	11.32	(a)	(a)
November	8,280	6.28	9,725	7.38	(a)	(a)
December	5,364	3.91	5,006	3.65	(a)	(a)
1927						
January	9,564	6.83	7,269	5.19	14,072	10.06
February	14,780	10.76	3,311	2.41	43,261	24.94
March	21,187	16.59	2,403	1.88	24,518	19.20
April	24,437	18.27	1,534	1.14	18,752	14.02
May	31,207	23.34	1,897	1.41	19,830	14.83
June	13,999	10.48	3,385	2.53	24,637	18.47
July	32,357	24.22	6,286	4.71	24,235	18.19
August	22,960	19.91	(b)	(b)	12,754	9.07
September	13,718	12.57	(b)	(b)	11,776	10.79
October	14,751	11.94	3,787	3.06	12,366	10.01
November	16,703	11.31	8,435	5.49	16,613	11.25
December	28,012	18.54	16,781	11.11	31,030	20.54

[a] Not yet started

[b] Rested due to disease

TABLE III—Continued

Months	System					
	V-shaped				Opposite V's	
	Daily		Alternate daily		Daily	
	Latex	Dry rubber	Latex	Dry rubber	Latex	Dry rubber
1928	*Cu. cm.*	*Pounds*	*Cu. cm.*	*Pounds*	*Cu. cm.*	*Pounds*
January	16,887	11.96	7,610	5.49	25,212	18.14
February	12,550	9.58	5,081	3.87	15,985	12.20
March	25,760	20.51	14,905	11.86	25,631	21.18
April	27,205	20.28	11,399	12.90	25,348	18.90
May	31,978	23.98	16,079	12.06	33,323	24.99
June	36,196	25.87	10,043	15.09	36,289	26.53
Total	556,962	423.29	247,785	198.64	406,632	285.12
Average	23,206	17.63	11,663	9.02	17,776	15.84

General average for the daily section.... 20,959 cu. cm. = 16.74 pounds
General average for the alternate daily section.... 13,556 cu. cm. = 10.39 pounds

It was found that the greatest yield was obtained during the months of July, August, and June, at which period the trees were in their fruiting stage. The least production was obtained in November, January, and December, during which time the trees were in their wintering period.

The general average monthly yield of the daily section was 21,292 cubic centimeters of latex, equivalent to 16.74 pounds; and that of the alternate daily section, 12,886 cubic centimeters of latex, equivalent to 10.02 pounds.

The alternate daily section in which the V-shaped method was followed was rested during August and September, 1927, because most of the trees gave very little or no yield and what there was coagulated so quickly that it would not flow into the collecting cups. Upon examination it was found that nearly all the trees were affected with the brown-bast disease while some had the die-back. The damp and low situation of the place from which the water does not drain quickly is supposed to be the cause for the occurrence of these diseases.

TABLE IV

System	Number of days actually tapped	Total actual production		Average yield per tree, Per day	
		Latex	Dry rubber	Latex	Dry rubber
		Cu. cm.	*Pounds*	*Cu. cm.*	*Pounds*
Half-spiral (daily)	577	525,522	402.09	23.92	.018
Half-spiral (alternate daily)	259	370,787	282.60	37.67	.028
V-shaped (daily)	574	556,962	423.29	24.25	.018
V-shaped (alternate daily)	249	247,785	198.64	26.89	.021
Opposite V's (daily)	424	406,632	285.12	27.99	.019
Total	2,083	2,107,688	1,591.74	140.72	0.104
Average	416.6	421,537	318.34	28.14	0.020

System	Per year[1]		Yield per acre in dry rubber[2]	Average yield of the daily and alternate daily sections	Average girth measurement
	Latex	Dry rubber			
	Cu. cm.	*Pounds*	*Pounds*	*Pounds*	*Inches*
Half-spiral (daily)	4,353.44	3.276	327.60	418.60	28.56
Half-spiral (alternate daily)	6,855.94	5.096	509.60		31.88
V-shaped (daily)	4,413.50	3.276	327.60	354.90	21.93
V-shaped (alternate daily)	4,893.98	3.822	382.20		18.61
Opposite V's (daily)	5,094.18	3.458	345.80	345.80	26.58
Total	25,611.04	18.938	1,893.80	1,119.30	127.56
Average	5,122.2	3.787	378.70	373.10	25.51

[1] Considering 182 as the number of tapping days per year.
[2] Considering 100 trees per acre.

Table IV shows the actual number of tapping days, actual total production, average girth measurement and the comparative yield by the different systems of tapping reduced to the yield per tree per day and per year per acre.[1] The totals and their corresponding averages are also given.

The total actual production by the three systems during the entire period was 2,107,668 cubic centimeters of latex equivalent to 1,591.74 pounds of dry rubber (cup washings and tree scrap included) or 34.32 per cent of the total latex.

The average yield per tree per day was 28.14 cubic centimeters of latex equivalent to 0.020 pound dry rubber or 5,122.2 cubic centimeters latex equivalent to 3.787 pounds of dry rubber per year. The average yield per acre of 100 trees in Baco, Mindoro, therefore was 378.70 pounds.

Comparing the total average yield obtained by the three systems when tapped daily and alternate daily on the per acre basis, it will be seen that the half-spiral, which yielded 418.60

[1] Acre=.4047 hectare.

pounds of dry rubber, gave the highest production, followed in order by the V-shaped and opposite V's, which gave 354.90 pounds and 345.80 pounds of dry rubber, respectively.

SUMMARY

1. During the course of the experiment it was observed that higher yields were obtained during the months of June, July, and August and lower yields during November, December, and January.

2. The average yield for the daily section, based upon the total actual production during the entire period covered by the experiment was 16.74 pounds of dry rubber and 10.39 pounds of dry rubber for the alternate daily section.

3. The yields computed per acre, by the three systems of tapping are 418.60 pounds of dry rubber for the half-spiral system, 354.90 pounds for the V-shaped and 345.80 pounds for the opposite V's.

4. The average yield computed per acre per year, based upon the total actual production of the three systems of tapping tested was 378.70 pounds of dry rubber.

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PRELIMINARY PARTIAL SHADE TESTS WITH WRAPPER TOBACCO IN THE COTABATO VALLEY

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This report aims to present the results of preliminary tests, using young coconuts and *Tephrosia candida* for partial shading for the production of cigar wrapper tobacco. The first experiment under coconuts and the second under *Tephrosia candida* were carried out in Pikit in the 1921–22 and 1923–24 seasons, respectively; the third using the second plant was carried out in the 1926–27 season at Sarunayan.

The value of artificial shading to tobacco fields for the production of cigar wrappers, is a well-known. The most common materials being used at present are cheesecloth in the Connecticut Valley, Cuba, and Porto Rico; wooden lath frames in Florida; and palm leaves in Cuba also. Artificial shading, however, involves a heavy outlay of money and to save this expense but at the same time get as much of the benefits that come from the practice of shading as possible, the use of living plants for partial shading was tried in the Cotabato Valley.

Stewart, as quoted by Paguirigan(2), claimed that the use of artificial shade for tobacco was accidentally discovered in Florida with tobacco grown in new fields where some trees had been left standing for lack of time to fell them. These shaded the plants and the result was the production of superior wrappers. The other instance known whereby living plants were used to furnish partial shade for tobacco was during the 1920–1921 tobacco season at the Dammao Tobacco Station of the Bureau of Agriculture(1). The plants used, however, were maize and cassava but because of typhoons, the experiment was discontinued there.

This report about interplanting tobacco in a young coconut grove, and trying to use *Tephrosia candida* to give the shade, simulating the shade given by young trees, and all other papers

the author has written to call attention to the great possibilities of the Cotabato Valley in the growing of wrapper tobacco.

The objects of these tests were: (1) to find out if cigar wrapper tobacco can be interplanted to advantage with young coconuts, the common permanent crop in the Cotabato Valley, and *Tephrosia candida,* (2) whether this shade-grown crop has an advantage in wrapper qualities and in quantity over the sun-grown, and (3) what cropping system can be recommended as a result of these tests.

FIRST TRIAL

1921–22 TOBACCO SEASON AT PIKIT. SHADE PLANTS, YOUNG COCONUT TREES

A young coconut plantation three years old occupying an area af 6,393 square meters that was interplanted with rice and corn for the first year, but neglected for two years up to the time of the experiment, was used. During the two years of neglect the young plantation was overrun by talahib, cogon, and other grasses and weeds.

An adjoining piece of land, 2,483 square meters which had about the same soil conditions and the same grasses and weeds as those growing with the coconuts was used for check plots.

Both plots were tractor plowed and disc harrowed. After the grass roots were sufficiently dried out or decayed, the land was again plowed by animal power. Both plots were laid out in rows 1 meter apart and the rows were ridged sufficiently high to insure perfect drainage. This ridging was done ahead of the transplanting.

Due to the different sizes of the plots and the lack of sufficient seed of certain varieties used, it was not possible to make the area devoted for each variety of equal size.

Three varieties of tobacco were used, namely: P. I. 8714 Philippine Florida-Sumatra, P. I. 8587 Philippine Sumatra, and P. I. 8711 Havana wrapper.

The seeds were sown in sterilized beds beginning October 1, pricked 7 centimeters by 7 centimeters into fresh unsterilized beds beginning October 17 and transplanting was started November 16 and completed December 21.

On the ridges the seedlings were transplanted 50 centimeters apart.

About the end of the year there was a dry spell, the rain record for December being only 43.9 millimeters. It was nec-

essary, therefore, to water the seedlings from December 31 to January 3.

The cultures both under the coconuts and in the open were given uniformly good care. The insects were picked off, weeds removed, and the small leaves and suckers pinched off and buried in the ridges immediately around the stems of the plants.

With the exception of the mother plants for seed production, the plants were topped when they started to bloom.

Harvesting of all the plots was started January 7 and continued throughout the month of February.

Curing the leaves was done in a curing shed 14 meters by 7 meters and inside care was taken not to hang partially dried leaves on the racks with the green leaves. All the poles with partially dried leaves were pushed to one end of the shed.

The results from the cultures may be tabulated as follows:

TABLE I.—*Results of the first trial, at Pikit, under young coconuts*

Variety	Shade culture				
	Area [1]	Total yield	Wrappers	Calculated yield per hectare	Remarks on the wrapper leaves
	Sq. meters	*Kilos*	*Per cent*	*Kilos*	
P. I. 8714 Philippine Florida-Sumatra.	4,757	560	45	1,177	Thin, uniform color, elastic.
P. I. 8587 Philippine Sumatra.	1,463	138	50	943	Thin, uniform color, very elastic.
P. I. 8711 Havana Wrapper.	173	13	20	751	Medium fine, not very elastic.

Variety	Open culture				
	Area	Total yield	Wrappers	Calculated yield per hectare	Remarks on the wrapper leaves
	Sq. meters	*Kilos*	*Per cent*	*Kilos*	
P. I. 8714 Philippine Florida-Sumatra.	2,200	271	35	1,227	Thin, elastic, darker colors than in the shade.
P. I. 8587 Philippine Sumatra.	170	20	25	1,176	Thin, not so elastic, colorado claro color.
P. I. 8711 Havana Wrapper.	113	9.5	10	840	Medium in fineness, dark color

[1] Land actually occupied by the tobacco, allowances being made for that occupied by the coconuts.

SECOND TRIAL

1923–24 TOBACCO SEASON AT PIKIT. SHADE PLANTS, TEPHROSIA CANDIDA

A piece of land 7,036 square meters, which was in grass and weeds and had been planted to tobacco for two seasons pre-

viously, was used. The land was cleared and plowed twice during June. On the 28th and 29th of the same month, *Tephrosia candida* seeds were drilled in rows 4.5 meters apart, running from north to south. The land was cultivated twice with a small-toothed cultivator while the *Tephrosia* was growing.

Tephrosia candida is a rapid-growing leguminous shrub that attains 4 meters in height when fully developed and may live for about 4 years. It can be easily pruned. The idea of the use of *Tephrosia* is to simulate the shade given by certain young trees.

An adjoining piece of land was not planted to *Tephrosia* but reserved for check plots.

On October 1, seeds of the following varieties were sown in sterilized seedbeds: P. I. 8587 Philippine Sumatra, P. I. 8293 Philippine Sumatra No. 1, P. I. 8294 Philippine Sumatra No. 2, P. I. 8714 Philippine Florida-Sumatra, and P. I. 8591 Bx-hybrid.

Pricking the seedlings into fresh unsterilized beds 1 meter by 8 meters was started on October 17, and continued to the end of the month.

Between November 15 and the end of the month the transplanting was rapidly done.

The spacing used for all the varieties except the Philippine Florida-Sumatra was 40 centimeters by 80 centimeters, permitting five rows to be laid between the *Tephrosia* rows; for Philippine Florida-Sumatra the distances used were 90 centimeters by 50 centimeters making it possible to plant four rows only between two *Tephrosia* rows.

In the middle of December and at the beginning of January cultivation between the rows was done by using alternately the same day a small-toothed and large-toothed cultivator in order to raise the ridges. In order to round off the apices of the ridges the soil was piled up by hand labor.

Harvesting by priming was started December 31 for the sand leaves and was carried on to the end of February.

The tobacco was cured in a shed of the same size as that described in the account of the first trial.

The check plots were simply the extended rows beyond the *Tephrosia* to the reserved open area. Unfortunately the check cultures failed to give satisfactory results as the plants were abnormally stunted in growth. This was due to hasty prepa-

ration of the ground and the lack of moisture during their development, the total rainfall for December being only 68.9 millimeters and for January, 27.4 millimeters. The tobacco under the *Tephrosia* did not suffer very much in this respect, as the ground was more moist than in the open.

The results of this second trial of growing tobacco under a new shade plant may be seen in Table II.

TABLE II.—*Results of second trial, under Tephrosia candida*

Variety	Area [1]	Total yield	Wrappers	Calculated yield per hectare	Remarks on the wrapper leaves
	Sq. meters	*Kilos*	*Per cent*	*Kilos*	
P. I. 8587 Phil. Sumatra..	4,095	147.3	45.6	369.7	Very fine, silky, and light colored
P. I. 8293 Phil. Sumatra No. 1.	826	66.1	39.7	800.0	Very fine, silky, and light colored
P. I. 8294 Phil. Sumatra No. 2.	826	58.4	28.6	707.0	Fairly fine.
P. I. 8591 Bx-hybrid......	463	29.4	27.1	635.0	Very fine, large, light colored leaves.
P. I. 8714 Phil. Florida-Sumatra.	826	69.6	31.0	830.0	Fine, uniform color, very elastic.

[1] This area included the land occupied by the *Tephrosia* which was approximately one-ninth of the whole area; the yield calculated per hectare for each variety was therefore less by one-ninth.

The results obtained in the check plots have not been placed with the shade grown results appearing in Table II, because for the reasons stated above, conditions were abnormal in these plots. What the varieties tested might do under normal conditions of growth is not known.

Since the shade-grown tobacco gave us the best wrapper leaves, it would be fairer to compare the shade-planting results with our best cultures in the open with the same varieties in nearby plots and grown during the same season.

TABLE III.—*Results of trials with the same varieties when grown in the open*

Variety	Area	Total yield	Wrappers	Calculated yield per hectare	Remarks on the wrapper leaves
	Sq. meters	*Kilos*	*Per cent*	*Kilos*	
P. I. 8587 Phil. Sumatra..	1,000	121.7	24.0	1,217	Very fine, colorado claro.
P. I. 8293 Phil. Sumatra No. 1.	683	67	24.2	981	Fairly fine.
P. I. 8294 Phil. Sumatra No. 2.	472	35.5	16.6	756	Fairly fine, colorado claro.
P. I. 8591 Bx-hybrid......	740	129	22.1	1,600	Large, fairly fine leaves, claro color.
P. I. 8714 Phil. Florida-Sumatra.	657	42.9	20.9	525	Large fine leaves, thick veins.

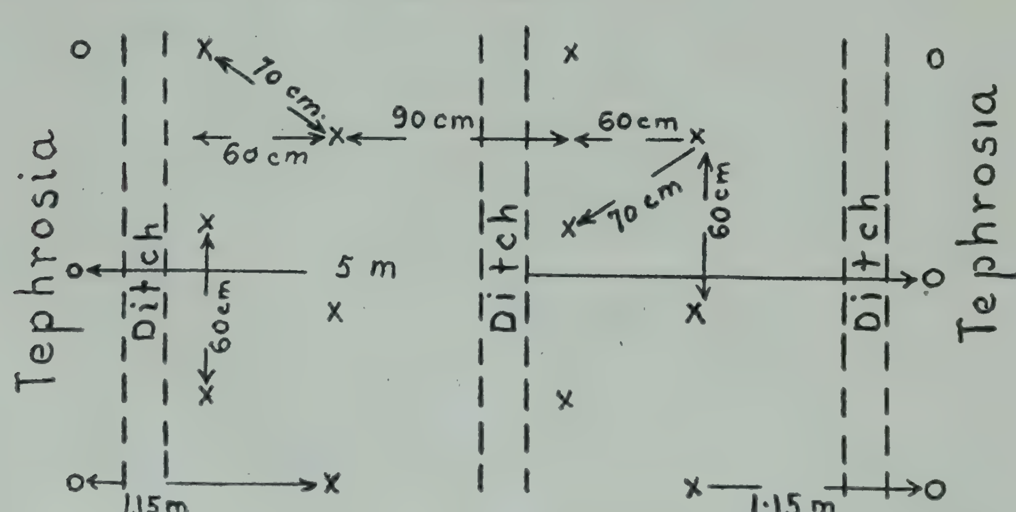
THIRD TRIAL

1926–27 TOBACCO SEASON, AT SARUNAYAN. SHADE PLANTS, TEPHROSIA CANDIDA

A hectare that had previously been planted to *Tephrosia* was used for the experiment. The *Tephrosia* was planted in rows 5 meters apart with the seeds sown in drills over a year before the experiment took place. The shade being very dense, the *Tephrosia* was thinned, leaving one-half meter between plants in the row. Another piece of land containing 2,000 square meters separated from the *Tephrosia* field by a road was used as a check plot.

Seeds of the variety P. I. 8587 Philippine Sumatra were sown in beds September 16, and another lot of seeds was sown on October 1.

From October 12 to the end of the month pricking of the seedlings into fresh beds 1 meter by 16 meters was done and from November 8 to 30 the transplanting in both plots. In the check plots, the distance used was 80 centimeters by 40 centimeters. Only four rows of tobacco were planted between two rows of *Tephrosia.* The method of planting was the Sumatra (3) alternate short and distant row method with the plants laid in triangles. The distant rows were 90 centimeters apart; the close rows 60 centimeters apart, and the plants of one row were 70 centimeters from the plants of the nearest row, as per the following diagram:



Previous experience in Pikit suggested the advisability of planting only four rows, so that the rows nearest the *Tephrosia* did not receive very dense shade. Moreover, the *Tephrosia* being full grown was taller than at Pikit. Every two close

rows were ridged together forming two beds between two *Tephrosia* rows.

Three shallow ditches were thus made between two rows of the shade plants. These ditches emptied into a large ditch at the northern side of the field. Another ditch was made at the eastern side of the field to prevent the water from coming in from the higher ground outside. Had it not been for these ditches, the crop under the *Tephrosia* would have been a total failure, as there was too much rain in December and January.

Due to the wider distance allowed between the *Tephrosia* and the tobacco rows, actually two-thirds of a hectare was occupied by the tobacco.

Table IV shows the results of this trial with the variety P. I. 8587 Philippine Sumatra.

TABLE IV.—*Results of the third experiment with Tephrosia at Sarunayan*

Treatment	Area	Yield	Wrapper	Calculated yield per hectare	Remarks on the wrapper leaves
	Sq. meters	*Kilos*	*Per cent*	*Kilos*	
Shade grown	6,666	290.6	60.0	425.9	Very fine, elastic, and mostly claro.
Check	2,000	172.8	29.3	864	Fairly fine, inclined to be colorado claro.

OBSERVATIONS AND DISCUSSION OF RESULTS

The 1922 crop was so far the best obtained by the station and our best wrapper leaves came from the tobacco grown under coconuts. The 1924 crop was the second best. According to the Tabacalera report some 416 cigars could be wrapped from one kilo of leaf, but it was stated that the number of cigars could be increased by protecting the tobacco plants in the field from the insect pests. The 1927 crop was not so good as the other two, but it is the best crop so far obtained at Sarunayan. Last season, the weather was very wet during the seedling and maturity stages and an unusual attack of insect pests and fungus diseases materially decreased our field for all our cultures. The leaves that were badly worm-eaten or badly attacked by fungus diseases were discarded at the harvesting time.

In all the experiments the total yield in the open cultures was higher than in the shade cultures. However, not much importance should be attached to these higher yields as thick tobacco is heavier leaf for leaf than thin tobacco.

In order to make clear the advantage of one treatment over the other in the production of fine wrapper tobacco, as the principal object in shading, the following table of the percentages of wrapper leaves is given.

TABLE V.—*Comparison of the percentages of wrapper leaves between two treatments for 3 trials*

Variety	Percentage wrappers		Difference in favor of shade-grown
	Shade-grown	Sun-grown	
FIRST TRIAL, PIKIT, 1921–22			
P. I. 8714 Philippine Florida-Sumatra	45.0	30.0	15.0
P. I. 8587 Philippine Sumatra	50.0	20.0	30.0
P. I. 8711 Havana wrapper	20.0	10.0	10.0
SECOND TRIAL, PIKIT, 1923–24			
P. I. 8587 Philippine Sumatra	45.6	24.0	21.6
P. I. 8293 Philippine Sumatra No. 1	39.7	24.2	15.5
P. I. 8294 Philippine Sumatra No. 2	28.6	16.6	12.0
P. I. 8591 Bx-hybrid	27.1	22.1	5.0
P. I. 8714 Philippine Florida–Sumatra	31.0	20.9	10.1
THIRD TRIAL, SARUNAYAN, 1925–26			
P. I. 8587 Philippine Sumatra	60.0	29.3	30.7

The percentages of wrappers appear low. This is because what we consider wrappers in the station are those fine leaves that are marketable and can be actually used for wrapping cigars. In this way an appreciable quantity of fine leaves that are very badly worm-eaten, broken in handling, or with too many blemishes caused by fungus infestations, are not included in these percentages. The medium fine leaves that can be used for wrapping low-priced cigars are considered binders and do not come within the wrapper class in this strict classification.

In every case the shade-grown tobacco gave more wrappers than the sun-grown. The difference varied from 5 per cent for P. I. 8591 Bx-hybrid to 30.7 per cent for P. I. 8587 Philippine Sumatra. Expressed in another way, the shade-grown produced from one-fifth to twice as much more wrappers than the sun-grown produced, the tendency being the doubling of the wrapper produced.

Observations of the cultures showed one important fact which does not speak very highly of living plants for shading purposes.

The development of the tobacco plants was uneven; the plants and rows very close to the coconut plants and the *Tephrosia* rows were smaller than those in the middle because of different degrees of exposure to the sun, the tobacco plants and rows immediately close to the shade plants receiving too dense shade for normal development. The leaves produced by these rows were smaller but thinner. The roots of the coconuts and the fact that the soil reached by them may be poorer were small contributory causes for this uneven development. The coconuts were more satisfactory than the *Tephrosia* in this respect. It may also be remarked here, in passing, that the cured leaves of plants close to the coconuts had a very slight flavor of coconut when smoked.

This uneven development was the cause of some of the very low yields obtained under shade when the season was normal.

Herein lies the superiority of the cloth tents, lattice work of laths, and palm leaves for shading tobacco over living plants in that the shade, particularly of the cloth tent, is very uniform. Moreover the utilization of the land is complete and with cloth tents the ravages of insects are under better control. With these advantages in favor of these materials, it stands to reason that should they be tried in the Cotabato Valley, the results will be far more satisfactory. The only question is whether the use of cloth tents would be as profitable as generally is the case in the advanced tobacco regions. The matter of profit would depend very much upon the reputation of the Cotabato wrapper, and this, in turn, would depend upon the proper development here of this highly specialized industry.

Young coconuts were used because they are the principal permanent crop. Many of the young coconuts here die before they become of bearing age due to weakness brought about by the ill-effects of the cogon roots and if that is not enough there are grass fires to finish them. The cleaning and cultivation of the abandoned tobacco plantation would materially help the growth of the young grove. In the case of this experiment the coconuts developed so well during the planting of the tobacco that an attempt to raise a second crop of tobacco the following season failed due to the dense shade. Since only the leaves are taken from the tobacco, leaving the stems and other parts of the plants in the place, the fertility of the soil is not exhausted thereby, as the wrapper leaves are of small

size and so do not take too much plant food from the soil, it is believed. Unfortunately, no analysis of the wrapper leaves produced during these tests was made. It may be interesting to quote here the analysis of leaves of shade-grown Havana tobacco, as reported by Paguirigan(4) in the Philippine Agricultural Review in 1923 as follows:

Properties	Per cent
Moisture	11.00
Phosphoric acid	0.77
Nitrogen	4.18
Potash	2.34
Crude ash	17.83

The average yield for all these tests for all varieties is 737.4 kilos per hectare. Judging from these figures, the soil fertility removed per hectare of shade-grown tobacco is approximately 5.8 kilos of phosphoric acid, 30.8 kilos of nitrogen, and 17.3 kilos of potash. Even doubling these figures to include the composition of the stalks and assuming that the analysis of our tobacco would show slightly higher figures than these, the wrapper tobacco crop cannot easily exhaust the fertility of our rich soil. The cultivation for the tobacco turned out beneficial to the grove. The most rational cropping method would be to have the tobacco followed by a legume crop, such as patani or palauan beans.

RUBBER AND TOBACCO CROPPING SCHEME SUGGESTED

As stated elsewhere *Tephrosia candida* was planted to simulate the shade produced by young trees. The most important deduction from this seems to be that instead of using *Tephrosia,* young Para rubber trees, 2 to 3 years of age from transplanting, might be planted to provide shade that is not so dense. In Sumatra forest land is cleared and cultivated laboriously by hand for a crop of wrapper tobacco once in 7 or 8 years, the land thereafter being left to return to jungle. Why could we not in the Cotabato Valley follow the tobacco with rubber or coconuts interplanted with perennial legumes? The advisability of this cropping seems apparent. The production of wrapper tobacco entails heavy expenses, but leaves the land in good tilth so it could be easily planted to a permanent crop and a leguminous crop with no more work than pulling the tobacco stems and laying them in rows. Moreover, should the weather conditions be disadvantageous for the wrapper crop, part of the

expenses could be charged to the permanent crop, and be recovered later. The scheme of cropping would be somewhat like the following: wrapper tobacco followed immediately by rubber with a perennial legume as cover crop. Parenthetically, it may be mentioned that the end of the tobacco season here is the beginning of the rainy season so advantageous for transplanting rubber. When the rubber plantation needs some soil stirring, this may be done in its second or third year and the land planted to tobacco again. The tobacco can then be followed by a legume. From this time on, no more tobacco should be planted in the rubber plantation. Concretely, then, the rubber land will have two crops of wrapper tobacco—one just preceding the setting out of the trees and another shade-grown—and two crops of perennial legumes following each crop of tobacco for returning the nitrogen removed and for cover cropping the young rubber trees.

CONCLUSIONS

1. Cigar wrapper tobacco can be grown successfully under young coconuts and *Tephrosia candida* in the Cotabato Valley. It is to be inferred from these results that other permanent crops, such as Para rubber, bananas, kapok, and young trees of a single species in a block that do not give very dense shade, may be used. In worn-out cogon lands, *Tephrosia candida* and ipil-ipil, *Leucaena glauca*, may be planted to give nitrogen to the soil and provide shade for the tobacco.

2. In every case the shade-grown tobacco produced a greater percentage of wrapper leaves than the sun-grown; the tendency being the doubling of the wrapper yield. The shade-grown wrapper leaves were of more even texture, more uniform and lighter in color, more elastic, and silky than the sun-grown. A second inference may be drawn: Imperfect and non-uniform as the shading of the tobacco was with these living plants and uneconomical the utilization of the land, it showed that growing tobacco under cloth tents may still give more remarkable results than these tests.

3. Judging from the development of the coconuts after the tobacco crop, and the fact that wrapper tobacco removes but little fertility from the soil, a cropping system, as outlined above, might advantageously be tried here, perhaps, with special attention to Para rubber as the permanent crop, and wrapper tobacco as the temporary crop.

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AGRICULTURAL CREDIT IN THE PHILIPPINES IN ITS DIFFERENT STAGES [1]

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INTRODUCTION

In any country where economic development has not as yet reached its full height, credit seems to be the slogan of everybody. Where there is any need for social betterment and a real desire for material improvement, credit appears to be the keyword which helps anybody solve the intricate problem of financing any enterprise.

The term "credit" is used with a great variety of meanings. A man is said to have good credit if he has the reputation among his business associates of paying his debts promptly when due. Credit, therefore, may be broadly defined as "the power to get goods in exchange by giving a promise or contract to deliver an equivalent at some future time." In short, credit is a promise to pay.

The most important service of credit is to facilitate the transfer of capital and thus to promote the production of wealth. But it must be understood that credit is not itself either capital or wealth. Wealth consists of economic goods and capital consists of economic goods used in the production of wealth. Now, credit is not a thing or commodity, nor does it create anything. No more wealth, no more capital, no more goods exist after credit is given than before. If capital is in the hands of the borrowers, it is withdrawn from the lender. Credit, then, is merely the agency of transfer.

Credit may be classified in a variety of ways. A common serviceable classification divides credit into five kinds: personal, commercial or mercantile, banking, public and investment, and agricultural credit.

Since my purpose is not to discuss credit in general, I will confine my study to that which vitally concerns us: agricultural credit.

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AGRICULTURAL CREDIT DURING PRE-SPANISH ERA

Agricultural credit is an old institution in the Philippine Islands, perhaps older than the most elemental banking system, as it was known before currency was used as a means of trade and commerce.

In olden times, when every able-bodied man was the owner of the lands he tilled because private ownership was not yet systematically regulated, credit was first conceived by the human mind as a necessity. From that immemorial epoch confidence was known and accepted as the only basis of contracts. No document was drawn nor was any public or private instrument needed to perfect a contract of debt between the lender and the borrower. The peddler trusted his goods to the farmer on the security of the latter's good faith and the reliability of his word. Human greed in those times was not yet rampant so everybody, the lender as well as the borrower, trusted that both parties would keep their words, as in fact they did.

The early merchants who came to the Islands and established trade relations with the inhabitants, were possibly the first to introduce the credit system in our business relations. They advanced goods to their customers, mostly farmers who lived in the valleys and in the foothills who once a week used to come to the town to buy foodstuffs on credit, and the next week bring chickens, vegetables and other crops they had raised to pay for what they owed or to exchange for what they needed. Thus credit was practically instituted in our farm life.

When trade relations were established in these Islands with those coming from other countries, the use of currency was known, and then the idea of obtaining goods on credit was reformed and the granting of loans in money began to be the custom. In all these credit transactions, however, the only basis was the confidence which the lender had in the borrower, and the reputation that the borrower had of paying his debts punctually.

The people began to acquire lands by occupation, not only to build their homes, but also to produce more crops and to save money for their future necessities. It was but natural that the more enlightened ones, especially those who had by inheritance or by force acquired some power to control others, should possess large tracts of lands; and then the tenantry system was little by little started, improved, developed to its worst stage, and made use of to oppress the unfortunate.

THE TENANTRY SYSTEM

The system of tenantry is founded upon custom. The custom did not originate in the Philippines. It is a custom that is older than the Biblical maxim, "To him that hath shall be given and from him that hath not shall be taken away even that which he hath." And probably accounts for that maxim.

Under the present tenantry system in the Philippine Islands, in relation to the credit transactions which the tenants have to enter into with their landlords, the tenant has no chance to get ahead of the game unless he is given a larger share of the crop than he produces or unless usury and "gouging" are eliminated.

This system created and made into custom the application of certain usurious methods that for many years have been sanctioned by the natural indolence of our people. The tenantry system added to our vocabulary the following words and phrases which became generalized afterwards: *pasunod, takalanan, kabig, talindua, takipan, baligtaran, medyang-palabasan, pamatá,* etc.

These Tagalog expressions have peculiar meanings and applications, as may be seen from the following definitions:

PASUNOD

Meaning: Something to follow with or to send along. This word applies to certain compulsory loans given by the landlord in advance to the tenants either in cash, merchandise, clothing or jewelry or other commodities. The tenants have to take what is offered as a loan, regardless of whether they want it or not upon starting work on the landlord's property.

The abuse committed by landlords in connection with this custom consists in charging the tenants a high price for the merchandise or commodity thus loaned which has to be paid back in agricultural products at the time of harvesting.

TAKALANAN

Meaning: The root is "takal"—to measure grain. "Takalanan" means to pay certain debts with agricultural products at harvest time.

When the tenant receives a "pasunod" from his landlord, the former has to pay it back in grain to the latter, when the crop is divided, the price having already been fixed at the time of contracting the debt, or according to conditions in the locality. If the tenant should receive a "pasunod" of say, twenty pesos upon commencing on the land of his landlord, an agreement would be entered into to the effect that the payment would be ten cavanes.

The "takalanan" system is also in vogue, not only in the commercial relations between landlord and tenant, but also between merchant and farmer, or middleman and grower, or in any case where the debtor is a producer and the creditor a money lender.

KABIG

Meaning: To take for oneself, or to get what is due one. If "pasunod" is a compulsory loan, "kabig" is a compulsory payment. Whenever the word "kabig" is used in any contract, it means that the debtor will allow the creditor to separate from the gross income or whole crop that portion which would pay for the debt contracted before under the "pasunod" system or for any ordinary loans made.

"Kabig" is known under two typical denominations:

"Kabig sa kuarta" means that the landlord is permitted to take his due from the proceeds of the sale of the products grown by the debtor at the time such crop is sold.

"Kabig sa palay" means that the landlord is authorized to take from the portion which might pertain to the tenant that part of the whole crop before same is sold, to apply to the debt of the tenant.

TALINDUA

Meaning: Contraction of two words "tatlo" and "dalawa" (three and two).

"Talindua" is the manner of paying a debt at the rate of three for two, that is, if the tenant owed ten, he would pay ten and five or 50 per cent more than the capital. This applies to all kinds of debts, either in grain or in cash.

TAKIPAN

Meaning: Covering each other or duplicating the number.

It is a more onerous manner of paying than the "talindua," for the reason that the rate becomes 100 per cent of the debt,—that is, if the tenant owed ten pesos, he would pay ten pesos plus another ten pesos as interest on the money. This also applies to all kinds of debts, either in grain or in cash.

BALIGTARAN

Meaning: Converting, or a queer mathematical process applied in the computation of the debt and the conversion of same from money into grain or vice versa.

The "baligtaran" process is now becoming obsolete, but it has prevailed a long time in the provinces of Bulacan and Nueva Ecija. The procedure is as follows:

Supposing that A (tenant) receives a "pasunod" or an ordinary loan of ₱50 to buy a carabao from B (landlord) which is to be paid in "takipan" or ₱100 in the harvest season, this will be paid in grain according to the "takalanan" system at the rate of two pesos a cavan or 50 cavanes.

At the harvest season, according to the process of "kabig sa palay," B will separate from the portion which corresponds to the tenant the fifty cavanes with which to pay his debt, but if the crop obtained from the land is not sufficient to pay said debt the unpaid balance will be converted into grain and valued according to the market value, say three pesos a cavan.

Supposing that A could pay back only thirty cavanes, then he would still owe 20 cavanes. These 20 cavanes valued at ₱3 a cavan, will be regarded as ₱60, which will again be converted into an ordinary loan payable at the next harvest season at the rate of ₱2 a cavan, and sometimes ₱1.50.

The balance will again be converted into grain, and then into money, and so on, until the tenant will be stuck in the quagmire of debt forever, and the landlord may be assured of getting all the crops of his lands without giving the tenant any share of his produce.

To see how a "pasunod" of one peso will grow if not paid in three years the following is given:

Debt contracted in 1905.. ₱1.00
To be paid in "takipan" it automatically becomes........ ₱2.00

At the harvest season it should be paid with ONE CAVAN of palay, but if not paid will be converted into money, according to the "baligtaran" process at the rate of ₱3 which will have to be paid in takipan, or at the beginning of the second year the tenant will owe ₱6.

To be paid in products which equal THREE CAVANES.

These three cavanes, if not paid at the harvest season, automatically become money at the rate of ₱3 or ₱9 which will again have to be paid in takipan or ₱18.

This is what the debtor owes at the beginning of the third year. And think what it means in 10 years or more!

MEDYANG–PALABASAN

Meaning: A grain measure which equals one-half cavan used in lending any kind of grains, either as husked rice, palay or corn.

The abuse in this scheme consists in using a larger measure in collecting than that which is used in lending. Petroleum boxes are often used instead of the legal one-half cavan measure.

PAMATA

Meaning: For the eye, or a certain payment made by the tenant in advance to the landlord so that the former may work on the land of the latter. Most tenants pay "pamata" to the owners of good lands, simply to be allowed to become their tenants. In fact, this is a charge made by the landowner to his tenants if he has first-class agricultural lands so as to compel the tenants to work on poor land.

USURY

Our study of this subject would be incomplete if we should not mention the severest of all evils in all social relations. I mean "usury." The question of usury is by no means a new one. It is almost as old as the human race, certainly as old as any financial system. In earlier periods of history, interest—payment for the use of money—and usury—payment in excess of the rate allowed by law—were used as synonymous terms, and any attempt to extract a fee for the use of a loan was looked upon as immoral. Solon, archon of ancient Athens, forbade it by law, a mandate which Socrates and Plato later endorsed on ethical grounds. In mediaeval England, as late as the thirteenth century, Parliament made all payments for the use of money illegal.

The impracticability of doing away with interest entirely by means of legislation has been commonly apparent, however, wherever attempted, and legislative bodies have for the most part given consideration to the question of the establishment and enforcement of fair and practical rates for loans rather than to measures for their complete suppression. That this question should be, as it is, one of universal interest is in itself indicative of the abuses to which the borrower everywhere has been subjected during many generations by the unscrupulous money lenders.

Possibly no other phase of human activity has suffered as much from the evils of usury as agriculture, because farmers have only two ways of obtaining the additional capital for their agricultural ventures and for securing capital for the equipment of their farms. One is to accumulate it themselves, by consuming less than they produce; the other is to borrow it.

To obtain money from a money lender, the farmer has to submit to all kinds of exactions. The different contracts drawn for this purpose are cautiously disguised, in order to appear legal, though in fact they are no less immoral than the immorality itself. With the view to inform those who ignore their various shapes and forms, Mr. M. V. Gallego related in his graduation thesis the different kinds of usurious contracts covered with the cloak of legality, as follows:

(*a*) *Deed of sale with the right of repurchase.*—The most universal form of contract employed by usurers to evade the law is this simulated sale with the right to repurchase. The document evidencing the debt is usually made before a notary public, especially when it involves a large amount; but it is drafted in such a way that the usurious interest is made to appear in the form of rent, either in money or in agricultural products as grain, varying from 20 per cent up to 100 per cent sometimes. Long before the passage of the Usury Law, our Supreme Court had always held that in every case where it could be shown that no sale could be shown; that no sale was intended, but simply a disguised loan, the transaction was to be considered nothing more than a mortgage. The inadequacy of consideration and the condition of the debtor was found at the time of the agreement to serve as a guide to the court in determining the true intent of the parties. According to the personal observation of the writer, more than 75 per cent of the total amount of money involved in usurious transactions is covered under this form of agreement, for the *pacto de retro* is always resorted to in large scale loans. In the native province of the writer there is a capitalist in a big town who loans as much as ₱50,000 a year under usurious *pactos de retro*. It does not require a far-sighted mind or a mathematical genius to estimate how much such a capitalist would earn during his lifetime if his illegal acts should remain unchecked. Add to this the number of such capitalists found in the different towns of the Islands

and you will have before you a graphic picture of the magnitude of the contribution of this contract in nourishing the social cancer called usury. It is to be noted, however, that big capitalists usually content themselves with loaning at a lower rate of usurious interest than ordinary lenders, for taken as a whole, their net gain is much more than that of the latter class. The work of the *pacto de retro* does not end with its use as a cloak to cover usury. It goes even further than that; it is also a means to escape payment of the internal revenue tax imposed upon those who habitually engage in loaning money.

(*b*) *Mortgage secured by real property.*—A loan secured by mortgage of real property is another but less common form of contract resorted to by usurers. The interest is sometimes deducted in advance from the capital and at other times added to it; but in either case the rate of interest charged does not appear on the face of the written contract. On the contrary, it appears that there is no interest at all, but in reality the rate varies from 20 per cent to 50 per cent. This kind of contract is used only when the debtor refuses to have his land sold with the right to repurchase. To clarify the matter let me cite an example. A, the borrower, approaches B, a capitalist, explaining to the latter his great need of money. B then asks A what security he (A) has to offer for the loan, and usually A has some documents or title of some real property with him for he knows that he would have a hard time to get what he needs without security. B afterwards examines the document and if he finds it satisfactory, he will proceed to ask how much A needs. The capitalist will then say that the contract is to be in the form of a *pacto de retro*, but if the borrower is reluctant to accept the proposition the lender will halt for a moment and then continue: "Do not tell others that your loan is only secured by a mortgage for we never loan money if not under a 'pacto' so they will envy you." Assuming that the sum loaned is ₱200 and the interest agreed upon is 25 per cent, the written instrument simply says that A owes B the sum of ₱200, if interest is paid in advance, or ₱250 as the case may be payable the next year. The description of the realty mortgage is then mentioned.

(*c*) *Pignoration of valuable papers.*—Whenever a needy person has no realty with which to secure his contemplated loan, then he brings with him a certificate of ownership of a carabao or a horse or a number of them to be given as a pledge on chattel mortgage. The animal pledged remains in the possession of the debtor and only the document evidencing the ownership is delivered to the creditor, but a separate agreement is entered into whereby the usurious rate of interest is made to appear as a payment or the lease of the services, of a carabao or other animal pledged. The rate of interest in this kind of contract is usually higher than the interest charged in case of loans secured by real property, the risk being usually greater for the animal pledged may die or be lost at any time.

(*d*) *Simple loans or promissory notes.*—In the absence of any property which can be either pledged or mortgaged, then a simple loan is resorted to. Simple loans may involve money alone, or agricultural products or seeds alone, or both. In loans of money the interest charged varies from 30 to 50 per cent. In case of seeds, the debtor is usually compelled to pay one and one-half times the original capital and in case of failure to pay at the specified time, the poor borrower is even obliged to pay double

the amount of the loan. Thus, if A for instance, borrows from B 100 cavanes of palay this year and A obliges himself to pay next year, under ordinary condition A has to return 150 cavanes then; but in case of his failure to pay at that time, B may renew the written contract and charge A 300 cavanes payable the next year. A contract of this nature was very common up to the passage of the Usury Law, but fortunately it is now less frequently resorted to. At present only small capitalists are guilty of this inhuman practice. Another prevalent form of simple loan is where the capital is in money while the interest is in agricultural products or grain—10 to 20 cavanes for every ₱100 of capital payable yearly. As in all other usurious loans already alluded to, in all of these varied forms of simple loans, the usurious interests never appear on the face of the instrument; only the total amount to be paid by the obligee or debtor is stated therein. Usury reaches its culmination under this form of contract for there being no security of any kind, exorbitant rates of interest are charged to counterbalance the great risk.

(*e*) *Purchase and sale of agricultural products.*—This form of contract denominated as purchase and sale is in reality and in essence a disguised usurious loan. This contract is usually entered into in or about the time of the planting or harvesting season when small landowners are badly in need of money and are therefore compelled to sell their crop before the proper time at the low price of from ₱1 to ₱2 a cavan only to buy again when the time comes, from the very same purchaser or from others, at a high rate varying from ₱2.50 to ₱3 per cavan. What is true of rice is also true of other crops or products such as sugar, abaca, coconut, etc.

(*f*) *Exchange of agricultural products.*—Another form of contract in vogue in the provinces is the exchange of agricultural products. Small farmers whose lands are not well adapted to the production of rice raise either sugar, corn, tobacco and similar products. Before the harvesting season, they usually lack the means of support so that they are compelled to borrow rice in time of need to be paid back later from what they produce. A cavan of rice is generally given for an amount of corn or tobacco sufficient to cover interest varying from 50 to 100 per cent. This practice is limited to places where lands are devoted to the production of different crops.

(*g*) *Fake deposits.*—A deposit is another means resorted to by the usurer to keep under cover his illegal acts. The amount of money loaned is always expressed in palay as per agreement and it is then reduced to writing. On its face the instrument makes it appear that the debtor is the depositary who obliges himself to deliver to the creditor, on a fixed date at a specified place, a certain amount of palay. The interest charged is always beyond the limits prescribed by law. Sometimes the usurer is not satisfied with charging an excessive rate of interest but goes further. Upon the failure of the debtor to pay the debt, for some reason or other, as in case of drought, the creditor brings a criminal action against the poor debtor for "estafa," since under the law it is one of the obligations of the depositary to deliver back the thing deposited by the depositor.

(*h*) *Peremptory loans.*—Another practice among usurers in the loan of money to be used for gambling where the rate of interest varying from 20 to 50 per cent is computed not annually nor even monthly but usually weekly and sometimes daily. If as I have already stated, the rate of

interest is as high as 50 per cent daily or weekly, I leave it to the reader to imagine its evil consequences. Contracts of this nature, however, are not only usurious but are expressly prohibited and unenforcible under the Gambling Law. (Act No. 1757, sec. 9.)

(*i*) *Lease of services.*—Lease of services whereby the debtor personally, or some other person in his behalf (his son or daughter), serves the creditor gratuitously in consideration of a certain sum received as a loan, is also resorted to by usurers; but courts always protect the poor under such circumstances. It is however to be regretted that although this practice is very common in the provinces, only very few cases come within the knowledge of the proper authorities and are given due consideration. So far, the writer only knows of one case decided by our Supreme Court regarding this point, where it was held that all usurious contracts are prohibited and that domestic service is always understood to be compensated and any agreement made in connection with a loan of money, whereby it is stipulated that, because of the loan such domestic services shall be absolutely gratuitous, is contrary to law and good morals. (Reyes *vs.* Alegado, 16 Phil. 499.)

(*j*) *Last resort.*—Since the passage of the Usury Law the minds of usurers have been kept busy inventing devices whereby to evade the law. Among the most common of these devices, is the taking of one note or the drafting of instruments in which the principal sum with legal interest appears in one document while the illegal excess appears in another, both of which bear different dates.

In reality, human ingenuity is limitless. It can devise innumerable ways of evading the provisions of the law, no matter how severe the law may be. Human legislation can only be counted on to lessen the power of an evil, but when an evil has already poisoned the blood of mankind and prostituted society and eaten into the human heart, it is absolutely impossible for any legislative body to stop it as it is impossible to legislate away human inclinations. Modern social workers have found that the only way of eliminating usury in all contractual relations is by stabilizing agricultural credits scientifically and systematically, to suit present conditions.

THE USE OF FARM CREDIT

Speaking of credit, everybody will agree with me that there is no magic in it. It is a powerful agency for good in the hands of those who know how to use it. It is, however, dangerous in the hands of those who do not understand it. Speaking broadly, there are probably almost as many farmers in this country who are suffering from too much credit as from too little credit. Many a farmer would be better off today if he had never had a chance to borrow money at all, or go into debt for the things which he bought. However, that is no reason why those farmers who do know how to use credit should be deprived of it.

The advantage of borrowing is that one does not have to wait so long to get possession of the tools and equipment. One can get them at once and make them produce the means of paying for themselves. Without them the farmer's production might be so low as to make it difficult ever to accumulate enough with which to buy them. With their help he may be able to pay for them, that is, to pay off the debt in a shorter time than it would take to accumulate the purchase price without them. That is the only advantage of credit in any business. But it is a great advantage to those who know how to use it.

PROPER AND IMPROPER USE OF CREDIT

Short-sighted people, however, who do not realize how inexorably the time of payment arrives, how rapidly tools wear out and have to be replaced, or who do not keep accounts in order that they may tell exactly where they stand financially will do well to avoid borrowing. Debts have to be paid with deadly certainty, and they who have not got the wherewithal when the day of reckoning arrives, become bankrupt with equal certainty.

On the other hand, there is nothing disgraceful about borrowing for productive purposes. The feeling that it is not quite respectable to go into debt has grown out of the old habit of borrowing to pay living expenses. That was regarded, perhaps rightly, as a sign of incompetency. It was then natural that men should not like to have their neighbors know that they had to borrow money. But to borrow for a genuinely productive purpose, for a purpose which will bring you in more than enough to pay off your debt, principal and interest, is creditable. It shows sagacity and courage and is not a thing to be ashamed of. But it can not be too much emphasized that the would-be borrower must calculate very carefully and be sure that it is a productive enterprise he wants the money for before he goes into debt.

OBJECTION TO THE USE OF CREDIT

The question may be asked, however, why did not the early guardians of society forbid borrowing instead of forbidding the taking of interest? The reason was that so long as the usurers were permitted to offer loans, many short-sighted people would yield to the temptation to borrow. Since the purpose for which they borrowed added nothing to their earning capacity, they were in no better position to accumulate money after they borrowed than they had been before. If they had been able to accumulate anything before, they would not have needed

money. The fact that they had not been able to accumulate anything before would be pretty conclusive proof that they would not be able to accumulate enough to pay the debt. Therefore they put themselves into the clutches of some usurer.

PRINCIPAL *versus* INTEREST

In the payment of a debt it is not the interest but the principal which gives the greatest trouble, except where interest rates are exorbitant. If a man borrows ₱100 for a year at ten per cent, he has to pay, at the end of the year, ₱110. If he borrows at five per cent, he has to pay ₱105. The difference is ₱5. Now, ₱5 is not to be despised. Good business consists in a large part in looking after such items as this. Nevertheless, it is only a little harder to pay ₱110 than to pay ₱105. The point is that the principal is the same in either case, and it is the principal which gives the greatest trouble.

The reason it has seemed necessary to emphasize this elementary fact is that many people seem to imagine that if interest on farm loans can be reduced from 10 per cent to 5 per cent, conditions will be made easy for the farmers. It is important that interest rates be lowered wherever it is economically possible, but it is vastly more important that farmers should learn how to pay back the principal easily. The only way to do this is to use the money borrowed in such a way as to put themselves in possession of the means of repayment. An unproductive enterprise is not a safe basis for borrowing under any conditions. In other words, it is of more importance that the enterprise in which one is engaged shall be a productive enterprise than whether the rate of interest at which one can borrow money is high or low.

IMPROVING CREDIT CONDITIONS

The point to remember therefore is that the farmers must have within their power the means to remedy these conditions themselves, though it may take careful planning and hard work. In the first place, they must disabuse their minds of the notion that tangible property such as land, furnishes the best security in the world. The business ability and character of the borrower are of even greater importance in such transactions than the value of the land he may own. Where farmers are known to be capable of paying their debts and willing to do so promptly and without legal proceedings, there credit conditions are good, because the right kind of lenders are attracted. The right kind of lenders do not like to foreclose mortgages or resort to any

form of legal procedure. They will keep away from any neighborhood where such things occur frequently, and leave the field to others less considerate. The right kind of money lender merely wants his principal back together with the stipulated rate of interest.

It must be admitted, however, that one farmer can do very little when working alone, to give his neighborhood a better financial reputation, or to attract the right kind of lenders. This is a problem which must be worked out by the whole community, or at least, by a considerable group of men.

Firm in this belief, that great man Frederick William Raiffeisen worked day and night to supply the people of Coblenz, Germany, in the distressing season of 1848, with the best means of improving their financial situation. Being moved to pity for the down-trodden poor, he organized a coöperative society for the distribution of bread and potatoes among them. The following year he founded at Flammersfeld a loan society for the support of the unprovided farmers, its members being rich philanthropists who sold cattle to unorganized farmers at easy rates. In 1862 he organized a third society at Anhausen which went a step farther, its membership being made up of the borrowing farmers themselves—and thus was developed a rural credit system that has carried aid to millions of farmers and whose boast is that no man ever lost a dollar in a Raiffeisen bank.

We can see the development of the idea—first a charity organization to relieve distress, followed by a philanthropic organization to assist the farmer to get back upon his feet, and then an organization of farmers helping and making themselves independent.

In this country, however, many years after the organization of coöperative societies of the Raiffeisen type in Germany, with the exception of the coffers of the usurers no other banking system for the farmers was known. However, the Philippine Government under the American régime organized the Agricultural Bank, but, though not a total failure it could not be considered a success. With the organization of the Philippine National Bank, the activities of the former Agricultural Bank ceased, and a Department of Agricultural Loans was opened in the Philippine National Bank, which helped big "hacenderos" with large loans.

The small farmers who have no bankable means remained as they were: "They had no credit because they were poor, and they were poor because they had no credit."

In this state of things, our legislators grasped the idea of inserting in our statutes a piece of legislation that in some way or other would help the farmers financially, and with no little difficulty Act No. 2508 was finally enacted in 1915. This is the present Rural Credit Law.

THE RURAL CREDIT ASSOCIATION

The rural credit association is not a new experiment. It has been tried out under varying conditions in different countries. It is discussed under various names, including the Schultze-Delitzsch societies in Germany which were started simultaneously with the Raiffeisen coöperative societies, the Luzzatti and Wollemborg types in Italy, the coöperative banks of Ireland, Austria, France, and Canada.

It not being my purpose to relate the history of rural credit associations, I will simply explain superficially what these associaitons are, where the need for such asociations may be said to exist, what the essential features of the organization are and what advantages the farmer may gain from them.

ITS COÖPERATIVE BASIS

There are many small farmers who realize the importance of improving their equipment and farming methods, but who lack the capital required to make the desired improvement. At the same time the terms on which they may be able to borrow the necessary funds are not such as to encourage them to do so. Their honesty and industry may be unquestioned, nevertheless their individual security does not command the desired confidence. But when a group of neighboring farmers are thus similarly situated, a coöperative rural credit association may supply the needed additional security by placing the collective good will of the group behind each of the members. Hence, it will be seen that a rural credit association is a society of friends and brothers who strive for their common good, a community association whose motto is "one for all and all for one."

It is not an ordinary financial concern, seeking to enrich its members at the expense of the general public. Neither is it a loan company seeking to make profit at the expense of unfor-

tunates who need loans, unemployed laboring men, agriculturists whose fields are suffering from the effects of drought or floods—a company having no mercy for its victims and not hesitating to impoverish them to the extreme limit. The rural credit association is nothing of the kind; it is the expression in the field of economics of a high social ideal. It is based upon the high conception, wholly just, equitable and fruitful, of "union for life" instead of "struggle for life."

Besides coöperation, confidence and mutuality should therefore be the backbone of these associations. Collective good will should be the spirit that ought to predominate in all their undertakings. It is very unfortunate that farmers who suffer from the limitations of their individual personal credit should not take advantage of the benefit of such collective good will. One of the most widespread forms of economic waste among farmers arises from failure to utilize the power of confidence and good will among neighbors. Of course, where conditions are such that neighbors do not trust each other and refuse to coöperate, it is futile to speak of collective power. On the other hand, where farmers are willing to take advantage of the added good will which a neighborly attitude affords, a rural credit association proves a helpful agency in promoting the increase of available capital and in strengthening the borrowing capacity of individuals.

FIRST STEPS TAKEN TO INTRODUCE RURAL CREDIT

The first steps taken toward the establishment of rural credit associations in this country were the organization of agricultural societies throughout the provinces. The object of the organization was that of systematic agricultural education in the principles of coöperation, thus paving the way for the establishment of rural credit and other enterprises of mutual or community value.

A number of years before our Legislature made various attempts to pass a law creating a special type of societies for the promotion of agriculture on a small scale, but these attempts met with no success at all. Then, as before said, Act No. 2508, known as the Rural Credit Law was enacted. This act provided for the organization of associations to be denominated "Agricultural Credit Coöperative Associations" and stated that the purpose should be "to accumulate funds, by means of coöperation, in order to extend to their members credit on reasonable terms for exclusively agricultural operations, and to en-

courage thrift, activity, and punctuality in meeting obligations among members."

The first rural credit society in the Philippine Islands was organized under Act No. 2508, in Cabanatuan, Nueva Ecija, October 19, 1916. Progress since that time has been quite satisfactory, and at the end of December 1926, there were in 42 provinces 544 rural credit associations, with a total membership of 87,535 and a circulating capital of ₱2,570,587.58, distributed among some 29,000 borrowers.

BRIEF SUMMARY OF WORKINGS OF RURAL CREDIT ASSOCIATIONS

Under Act No. 2508 all rural credit organizations must incorporate in accordance with the Philippine Corporation Law, Act No. 1459. There must not be less than five nor more than fifteen incorporators, from whom five directors are selected. The municipal treasurer of the municipality where the association is to be located acts as ex-officio treasurer, without any additional compensation. Shares to the full amount of the capital stock may be sold to any person in the locality who has the reputation of being honest and industrious, and each member of the association is limited to but one vote irrespective of the number of shares he or she holds. Par value of the shares must not exceed ₱5 each, though the usual price of shares in most associations has been placed at ₱2 to make them popular with persons of limited means. The law grants special exemptions and privileges not enjoyed by other corporations.

Once incorporated, an association may engage in the following operations: Extend credit to the members for securing title to and registering their land and for purchasing and securing title to new agricultural land; for the purchase of live stock, fertilizers, preparations for the destruction of pests of various kinds, and for the purchase of seeds, machinery, or implements which the borrower shall use for agricultural purposes exclusively for the redemption of encumbrances on agricultural land; for the cultivation and improvement of such lands; for the expenses in connection with the planting, cultivation, harvesting or care of any agricultural crop or product, or storage and housing until sold or marketed; upon gathered products stored in a safe place and at the disposal of the association, and for the construction, repair and maintenance of irrigation or drainage work. Associations are further authorized to contract loans from the Philippine National Bank and the Insular Gov-

ernment; to acquire or purchase seeds, fertilizers, preparations for the destruction of pests of various kinds, machinery, live stock and agricultural implements of any kind and sell the same to the members of the association.

In practice the application of the machinery of this law is very simple. The money received from the members for the sale of shares or for deposits is given in small sums as loans to those members in need. The directors meet and receive applications for loans. They decide on the merits of each case. The cases of the poorest and most needy who have a legitimate productive use for the money are supposed to be considered first, as the association is limited by law to one municipality. The character and reputation of each applicant is known, and if he furnishes two securities to sign his note to guarantee its prompt payment, the loan is voted.

The law requires that sufficient security be taken for each loan. Three kinds of securities are permitted: personal, chattel mortgage, and real estate mortgage. Associations are advised to make only small loans of ₱100 or less, though larger loans have been authorized for exceptional cases. Loans cannot be made for a longer period than one year, but they may be renewed if in the judgment of the board of directors there is valid reason for so doing. The rate of interest is 10 per cent per annum. Loans may be made only to members of the associations, and every member is required to own at least one share of stock. No director is permitted by law to vote on a loan for himself or for any member of the family. The combined credit of the association serves as an inducement to secure deposits not only from members but from outsiders as well, thus adding a savings-bank feature and also increasing the loaning capacity and working capital of the institution.

The administration and government of these associations are largely in the hands of the members, although there is Government supervision and audit and as a further measure of safety the funds are held by a bonded government official.

These associations represent a simple form of banking. When the people of a community have collected a sum of money by coöperation, they all feel a personal interest in their enterprise and watch the loans made and the security given. The utmost publicity is invited. This stimulates interest and attracts new members; thus the funds and the ability to administer them, advance together. The very struggle at the beginning to secure funds, makes better and more self-reliant members and

promises greater success than if all difficulties and obstacles had been removed by mistaken but well-meaning philanthropists.

A moment's reflection will convince one that these associations appeal to one of the strongest ties that human beings possess—a sense of brotherhood. They do not approach sentimentalism nor, on the other hand, are they so fiercely commercial that they can not be helpful. Careful business rules govern all the transactions, but a man is not made to feel that he has a premeditated idea of not paying his debt when he applies for a loan. He feels a confidence in an institution in which he is a part owner and he will value and respect the membership more and more as his understanding of the plan and its utility is enlarged by experience and observation.

These credit associations are unquestionably training people with limited ability and small means to grow by their own efforts. The plan for advancement and growth is elastic and progress depends upon the coöperation of all. No better system is known to develop self-help, to enable self-respecting people to create a system of finance for themselves without asking or receiving charity or gifts. A great advancement toward our economic independence will be made when the money now taken from the small agriculturist in ruinous interest remains with him through the agency of these rural credit asociations.

Only a start has been made, it is true, but it is a start and a good one, based upon sound economic principles. The smallness of the loans and the limited capital secured may appear to be insignificant to men of large affairs, but it should be remembered that it is just this class of small farmers, small investors, small borrowers, that this system is designed to help. Big business is reasonably well taken care of. The progress made in developing rural credit may appear small, therefore, but it is reaching a class of people that can apparently be reached in no other way, and is aiding them by simply teaching them how to profitably help themselves through coöperation and mutual confidence.

ANSWERING CERTAIN CRITICISMS

That some obstacles are encountered in the management of our agricultural credit coöperative associations is not at all surprising. These exist in every field of human endeavor. It is true in these Islands as elsewhere, because human greed and selfishness run in the veins of mankind the world over. The rural credit associations being a human undertaking, the man-

agement and supervision of which are entrusted to a group of men who are just as human as any other men of whatever color, nationality, and creed, must naturally meet their own obstacles.

The general criticisms which have been uttered in some political circles or launched in the local press are more or less, as follows:

1. That only large proprietors can get loans from the associations;
2. That the intervention of politicians and landlords in the management of the associations is dangerous;
3. That the people have lost their interest in the rural credit work;
4. That the associations are poorly managed and that they are morally and financially a losing proposition;
5. That there are many delinquent borrowers; and
6. That the whole work is a total failure.

That only "large proprietors" can get loans from the rural credit associations is untrue. Out of the 29,000 borrowers, not even 50 can be considered large proprietors in the strictest sense of the appellation given, nor are there 100 borrowers who could each obtain a loan of ₱1,000 in spite of the liberal provision of the Rice and Corn Fund Act, No. 2818, which establishes ₱1,000 as a maximum for individual loans. A farmer who needs ₱100 or ₱500 a year for his agricultural venture can not, under any circumstance, either here or elsewhere, be regarded as a large proprietor. Hence it will be seen that the asseveration that only large proprietors can be benefited by the funds of the rural credit association is too far from being true.

That the intervention of politicians and landlords in the administration is dangerous, is an erroneous conclusion. In this country where political agitation is so intensive that every person and group of persons think they are called upon to partake in all political movements, it would be next to impossible to determine and point a finger at one who is not a politician, if politician means a man who is actively engaged in politics. If he is an influential man in the locality he is either a prospective candidate or a leader of a certain party or at least the head of a dozen electors. If he is an average man in the barrio who seeks to help improve his community by having good roads, markets or schools, he must necessarily be a petty politician who attends political meetings, hear political harangues and then makes his own comment and selection as to the best candidate for whom to vote. But if the critic alludes to the professional politicians or what we call "vividores políticos," I can say that this type of politicians constitute so very insignificant a group that no man of optimistic ideas should be worried thereby.

It is true that in some cases persons holding political positions, otherwise known as "caciques," have used the local rural credit associations to favor their interests, but such cases can not be taken as a general defect of the majority of the rural credit associations. On the contrary in many cases persons holding political positions have helped rural credit associations in such a way that they even confounded this help with their official duties. That some of them have favored their friends and relatives is purely human. It is difficult to expect any one to render more help, when the question of helping comes, to his opponents and detractors, than to his supporters, adherents and kin. This is purely a matter of personal discretion and the effect of democracy.

That the people have lost interest in this patriotic move, is an affirmation that can not be sustained. The statistics show that in 1927 there was an increase of 3,500 in membership, and ₱23,000 in capital stock in the 544 rural credit associations.

That these associations are poorly managed and that they are morally and financially a losing proposition is refuted by proofs taken from the figures shown by the statistics. Any ignoramus in accounting who should happen to look at the balance sheets of these associations, if figures do not lie, would at once be convinced that the operation of these small local banking institutions is a gaining proposition, speaking in plain business language. The total income the year before last was ₱640,158.41, and after they had set aside for the Reserve Fund the sum of ₱11,400.60 and ₱9,423.94 for the dividends account, still there was an undivided profit of ₱702,963.62.

In the twelve years the associations have been operating we have found no need of opening in our books "Profit and Loss Accounts," for the simple reason that they are conducted and managed by public-spirited servants who draw no salary, and that all the income goes to the Profit Account. With rare exceptions, from the presidents of the boards of directors to the treasurers, they receive no remuneration. We are proud to say that not even a single centavo was lost from alleged "maladministration." The only losses which have been sustained have been due to defalcations committed by their treasurers.

It would therefore be more than unjust if the directors who are serving without any pecuniary compensation and have pledged their property to insure the fidelity and conscientiousness of their acts should be drastically dealt with for their minor shortcomings. Allowances ought to be made for them

because of their inexperience and efforts should be made to help them in all their honest endeavors.

That there are many delinquent borrowers in our associations is a fact, but such a state of things in any coöperative movement is also true everywhere. Legal proceedings can be resorted to any time a borrower fails to pay his debt, but in a coöperative asociation, brothers should not hale each other into court if it can be helped. Extrajudicial steps should be resorted to only when the borrowers can not be made to pay their debts in any other way. The association is not after the ruin of any fellow member.

As to the whole work being a total failure, this much can be said: That every new enterprise, plan or invention, has also been considered as a failure at the beginning, but the end is that which gives it due justification.

CONCLUSION

In general, the institution of the rural credit system in the Philippines has brought the common mass to a higher social standard, in that instead of depending on private money lenders they have begun to learn to put part of their income in a coöperative common fund in their locality so they may obtain relief afterwards whenever they are in distress. It is unnecessary to add that the system has been helpful in so far as economic conditions in the localities where agricultural credit coöperative associations exist are concerned, because every little amount given to a real farmer and properly invested in a productive agricultural venture means an increase of production, and consequently an improvement of their "modus vivendi," socially and economically.

It is therefore the paramount concern of every person who has at heart the interest of his fellow citizens to point out to every member of these small local credit institutions in particular and the civic-spirited people in general, their rights and duties to make the rural credit system as successful in these Islands, as it has become in some other countries. Little by little the truth that their salvation lies in their own hands must be instilled into their minds—that it is within their power to oust from their association the undeserving elements and select from among themselves men who they think will work for the general welfare of the community.

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THE WAMPI (WAMPEE)—A VALUABLE FRUIT

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INTRODUCTION

Since the establishment of the Bureau of Agriculture in the Islands about 25 years ago hundreds of species and varieties of plants have been introduced into the Philippines from different parts of the world. These introductions include fruits, vegetables, forage plants and other species. Some of these plants are very valuable while others are less so; some have proved well adapted to our soil and climatic conditions, and others are less well suited. One of these introductions which has been found to be adapted to the conditions prevailing at the Lamao Experiment Station, Lamao, Bataan, is the wampi. The following is a brief write up on the wampi, its origin, culture and uses.

HISTORY

The wampi, *Clausena wampi—Cookia punctata—Clausena lansium* sk.—*Rata-karapincha* S., is a fruit of Chinese origin and was introduced into the Philippines from India as early as 1912. The tree belongs to the Rutaceae or Citrus family. Two trees were set out at the Lamao Experiment Station, Lamao, Bataan in 1915. One of these fruited for the first time in 1924 but never since.

In 1920, another wampi plant was set out in the field of the same station and it is this tree that bore fruits for the first time from February to May, 1928.

DESCRIPTION

The wampi or wampee is a small tree attaining a height of about 6 or 7 meters, with many of its branches arising from near the surface of the ground. The leaves are impari-pinnate, with alternate leaflets, oblique or unequal at the base, pointed, leathery, dark green to light green in color with yellowish green venations, from 8 to 15 centimeters long and from 4.5 to 8.5 centimeters wide.

The fruits are borne in loose clusters and are arranged like those of the lunao, *Otophora fruticosa* Bl. The pale yellow berries are almost of the same size as grapes, with grayish dots all over rather a rough skin and rounded with a distinct navel. The color of the pulp is almost the same as that of the lanzon and it is divided into 5 or 6 lobes. The fruit is eaten fresh when fully ripe. The clusters of fruits consist of from 10 to 40 berries. The fruits are used as well as the fragrant leaves for flavoring meat curries, etc.

The trees of wampi at Lamao are of two varieties, one producing fruits which are slightly acidic and with seeds, and the other sweet and seedless ones. A tree is also growing in our Demonstration Station at Lipa, Batangas, and is said to be bearing sour fruits with seeds.

SOIL AND CLIMATIC REQUIREMENTS

The wampi is said to thrive in a mixture of loam and peat in humid districts at medium elevations. Under Lamao conditions the trees seem to do well in sandy loam with but little care. In fact the existing trees, including the small ones, at Lamao are growing vigorously and two of them bore fruits after 9 and 7 years, respectively, in spite of the dryness of the place. The tree is worth while cultivating and it is expected that the seedless fruit variety may find a good market in the Islands like the grape.

PROPAGATION

The wampi is said to be propagated by seeds. At Lamao, cuttings of second-growth wood of wampi without leaves have successfully rooted when planted in a mixture of sand, compost and ordinary soil, placed under a nursery shed in a plot or bed. The wampi can be propagated also by grafting, budding, and marcotting without difficulty. Plates XLIX, L, and LI show the results of the newly tried methods of propagating this plant with 66, 75, and 100 per cent success, respectively, for each of the aforementioned methods of vegetative propagation. Marcotting takes only about two months up to the time of separating the rooted branch from the tree.

PLANTING DIRECTIONS

In planting wampi, holes about 60 cubic centimeters deep 6 to 8 meters apart should be dug, and the seedlings or plants planted not deeper than they were planted in the nursery bed or bamboo tubes or pots. If the plants are in bamboo tubes,

simply split each tube longitudinally into halves leaving one half in the hole so as not to disturb the roots. If the plants are planted in beds, care should be taken to cut off the injured or broken roots before planting. The hole in which the plant is to be planted should be filled with rich, mellow, well-drained soil whenever possible. The soil in the hole should be made compact enough so as not to leave any air space or vacuum around the roots of the plant and no depression left around the base of the plant in which water will stand after watering.

REFERENCES

MACMILLAN, H. F.: A Handbook of Tropical Gardening and Planting. 1910. 524 p. XVI. Colombo: H. W. Cave & Co.

ANONYMOUS: Dictionary of Gardening, I, p. 371.

Wampi, *Clausena wampi* showing a bunch of fruits

Wampi grafted on wampi

Wampi budded on wampi

Marcotted wampi

OBSERVATIONS ON THE TEA INDUSTRY OF JAVA AND INDO-CHINA

By F. G. Galang
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PREPARATION

In Indo-China the natives prepare the tea as follows: The branches and leaves, irrespective of their sizes, are chopped into small pieces and are pounded in wooden mortars with hot water, then placed in earthen pots or jars for two days to ferment before being dried in the sun. A very poor quality of tea is produced by this method and this is used only by the natives.

In Java at the Goalpara Tea Estate tea is prepared as follows:

1. Only the first or at most four young and opened leaves are picked during the day—usually between 6.30 and 3 o'clock. Old leaves harvested by mistake are picked out by women. These young leaves are spread thin—from 3 to 4 centimeters or 3½ pounds to the square meter—on netted wire shelves to wilt overnight and are crushed and prepared the following morning, but sometimes withering takes place from 18 to 24 hours. The wilting racks, placed 15 centimeters one above the other, are provided with ventilating windows to regulate the temperature. Room temperature is maintained during the wilting process. Care is taken to let the leaves wilt just enough—not too much nor too little—as otherwise the quality of the tea produced is poor. If the atmosphere is too cool the windows are opened to admit hot air from the engines and if too warm they are closed.

2. The wilted leaves are then crushed by means of rollers that revolve under their own weight in order not to break the plant cells but the leaves are sufficiently broken to remove the water or sap from them and thus better fermentation is obtained. The leaves are placed in vacuums below the rollers. The crushing of the wilted leaves is done as follows:

a. For 15 minutes the rollers are allowed to revolve with practically no pressure, so as not to break the leaves.

b. For 5 minutes with a very light pressure—enough to crush the leaves.

c. For 10 minutes with a rather heavy pressure—enough to extract the sap or water from the leaves.

3. During the first machining the leaves are turned into balls and these are passed through the so-called ball-breaker where they are broken up into smaller pieces. The ball-breaker is a sort of a revolving machine which is capable of breaking the balls of leaves. The broken balls are then sieved in order to secure better fermentation—smaller leaves will ferment faster than the coarser ones. The sieve is of one-third of an inch mesh and 9 meshes to the square inch, and is adjusted so as to have the coarse leaves fall to one end and the fine ones passed through the sieve.

4. Properly sieved leaves are now fermented in the fermenting racks, piled about two inches thick on each of the fermenting trays, which are made of wooden frames with netted wire flooring, and so arranged as to permit the free access of air. Each tray has a capacity of 60 to 70 pounds of tea leaves. To obtain a better quality of tea the coarse leaves are fermented separately from the fine ones. The latter will take about $1\frac{1}{2}$ hours and the coarse leaves $2\frac{1}{2}$ hours to ferment.

5. *Drying.*—The "Sicocco dryer" with a capacity of 350 pounds per hour is employed in this estate. It consists of a big chamber with a revolving fan to regulate the temperature, and eight drying trays arranged in such a way that during its operation the tea drops from the uppermost tray to the next lower one and so on until reaching the bottom tray, where there is an outlet for the dried tea, which process takes about 15 to 20 minutes. The lower tray usually gets the hottest air during the course of drying. The hot air is furnished by an engine outside and enters through one of its bottom corners. The temperature of the dryer is kept at 80 to 90° C, and this is indicated by a thermograph with curves drawn as the heat is fed to the dryer. A hotter temperature than this will burn the tea. The feeding of the dryer is done by one man at the top where the fermented leaves are being spread evenly by the operator as he feeds the dryer. A loss of about 30 per cent moisture from the leaves has been recorded after drying the tea from the fermentation racks.

6. Sorting is done as follows:

a. The dried tea is broken up by an apparatus called the cutter, which makes about 30 revolutions per minute. The broken tea falls off into the revolving and rounded sieve with 14, 8, 6, and 5 meshes to the square

inch arranged one below the other. These successive sieves are slightly inclined in order that the tea will fall to the bottom without any difficulty. Each of the sieves is provided with parallel wooden braces and an iron bar for support.

b. Coarse tea that has escaped from the first operation is again cut and sieved as previously.

c. The dust and the finest tea leaves are then sifted in the "Jackson" sifting machine, and those that have escaped from this machine are worked out in the native system similar to that used in the Philippines in removing the tiki-tiki and rice hull of palay. The bamboo "bitchays" employed are of various meshes.

d. All leaf stalks are picked by hand from the different grades. This is done by women, and each woman is able to clean 10 to 15 pounds of tea in a day.

e. The finished tea is graded by the company as follows:

1. Orange Pecco (OP)
2. Broken or Pecco (BOP)
    - *a.* BOP No. 1
    - *b.* BOP No. 2
3. Broken Pecco (BP)
    - *a.* Br T No. 1
    - *b.* Br T No. 2
4. Pecco Souchong (PS)
5. Fannings (PF)
6. Dust (D)
    - *a.* D No. 1
    - *b.* D No. 2

When tea brings good prices grades 2, 3, and 6 are not divided into (*a*) and (*b*) but sold only as one class.

7. *Packing.*—All properly graded teas are placed in a tea chest compartment lined with tin and this compartment is divided into as many divisions as there are classified grades of tea. The finished product of each grade is stored in the room or division where it belongs. Each of the divisions is provided with a hole at the bottom for the tea to pass through when ready for packing.

Tea is packed either in cases, paper or aluminum-foil with tissue paper inside. The six different grades are packed in boxes as follows:

Grade No. 1	80 lbs. net
Grade No. 2	85–90 lbs. net
Grade No. 3	90 lbs. net
Grade No. 4	in packets of 1, 1/2, 1/4 and 1/10 lb. (aluminum-foil with tissue paper inside)
Grade No. 5	100 lbs. net
Grade No. 6	110 lbs. net

The boxes are somewhat loosely filled only and not tightly packed so as not to break the tea while in transit. To effect this the boxes filled with tea of different grades are put at the top of a machine where they are shaken so as to settle the contents by their own weight and not break the tea, which would injure its quality.

Care is taken to mix the product of each grade before packing in order to produce a uniform and standard product for the market. It has been discovered that tea produced one day is somewhat different in appearance from that produced another day. The mixing is done in canvas by hand.

Green tea.—Green tea is prepared by steaming the green leaves, instead of withering, and by omitting the fermenting process. The green teas are graded into young hyson, hyson No. 1 and 2, gunpowder and dust.

CULTURE

Tea is cultivated and found growing well even at low elevations with an evenly distributed rainfall of from 100 to 150 inches a year, but it is said that at lower altitudes the quality of the product is inferior. It is said that 4,000 to 7,000 feet is the best elevation for this plant. The Goalpara Tea Estate has an elevation of 3,600 to 4,500 feet above sea level. At lower elevations tea is grown under the shade of leguminous trees.

Planting is done by stake or stump and plants are distanced 8 feet between the rows and 6 feet between the plants in the rows, and are only allowed to grow 4 to 5 feet high. To induce the growth of the young shoots and to obtain the maximum quantity of the best quality of leaves regular pruning is practised on old plantations every 1½ to 4 years, when the plants are reduced to about 2½ or 3 feet in height, but the frequency of pruning varies much with the elevation, soil, variety, cultivation and the manner of plucking the leaves. The old as well as the young branches are removed and the top of the tea plant is made as level as possible by "tipping" or breaking the tips of the primary shoots. Every time pruning is done the ground is changkolled in alternate rows.

Helopeltis is so far the most dangerous insect found to attack the tea leaves. This insect is picked off by hand and no spraying has yet been found practicable to kill this pest. The tea tortrix, and shot-hole borer do a certain amount of damage in Ceylon. No serious diseases are found affecting the tea plant

except the root disease but this is under control in Ceylon. Leaf diseases are known but these are not of much importance.

Harvesting commences when the plants are about 2 years old or when they have made a growth of about 2½ feet. Picking is done every ten days, and as a general rule only the first three or four opened leaves are picked for tea production. A woman can pick an average of 40 pounds of fresh leaves in 4½ hours. Tea produced from the old leaves sells at a very low price because of its poor flavor. The old leaves have a very strong taste, which is also objectionable.

The data given the writer on the production per bouw [1] at the Goalpara Tea Estate are as follows:

Year	Yield in pounds		Year	Yield in pounds	
	1910 planting	1892 planting		1910 planting	1892 planting
1913	168	493	1920	467	1,109
1914	430	935	1921	412	883
1915	449	1,098	1922	360	1,132
1916	472	1,190	1923	655	1,308
1917	535	1,330	1924	719	1,403
1918	707	1,195	1925	812	1,383
1919	728	1,230			

The low yield obtained in 1921 was due to diseases.

The yields in other plantations ranged from 300 to 1,200 pounds per acre. A yield of 600 to 700 pounds is considered good yield.

The full production of tea is attained at the age of 8 years.

At the Goalpara Tea Estate tea plants about 32 years old were fertilized for the first time only about 7 years ago. Two hundred ten kilos of ammonium sulphate and 860 kilos of copra cake applied singly per bouw have been found to be the best fertilizers there when the application is made around the plants.

Green manuring is done very extensively on tea plantations in Java. This is accomplished by cutting off the small branches of leguminous trees or bushes planted between the tea plants, chopping them small and burying them in the ground between the tea. *Albizzia moluccana, Deguelia microphylla,* and ipil-ipil are commonly used.

Figures on the cost of field operation at the Goalpara Tea Estate are as follows in guilders or florins:

1. Felling, burning and planting, F250 per bouw.
2. Cultivating young field, F50 per bouw and F25–F30 for old field.

[1] Note: 1 bouw equals 0.7096 hectare.

3. Changkolling, F20 per bouw including the digging of catch drains 2 feet deep.
4. For picking one pound of fresh leaves, F0.11.

The capital cost per acre of other tea estates in Ceylon ranged from ₱339.50 to ₱970 during the first five years, with a greater cost for the first four years. This includes machinery, cost of its installation, etc. A good tea estate can realize from ₱2,182.50 to ₱2,910 per acre.

Note:	F1.00=₱0.80.	1 Acre=0.4047 hectare
	G1=₱0.97	1 Bouw=0.7096 hectare

General view of the Goalpara Tea Estate, Java

Partial view of a tea plantation, Siantac, Sumatra

Pruned tea plants with legumes between the rows for green manuring purposes, Goalpara Tea Estate, Java

Fertilizing tea plants after they have been pruned

Changkolling a tea plantation after pruning, Goalpara Tea Estate, Java

NOTES—FOURTH QUARTER

OUR NEW UNDER SECRETARY

"Let George do it" must be the favorite dictum of the powers that be when they are in a quandary as to who should hold a certain position in need of a trustworthy occupant. For "George" Vargas, as he used to be known in his college days, has held almost every executive position available and vacated, since he entered the Government service. Vargas was not the original George but he answer well to that name.

Since his school days he has been in one way or another a regular headliner. In college he was more than once a headliner, as when he wrote a plain but forceful article on the "Philosophy of the Filipino Farmer" in the College Folio, which was honored by (adverse) editorial comments in the local papers, for it was too forceful and faithful a picture of peasant life as he saw it; and at his last graduation when he emerged a valedictorian with a prize thesis.

His public service began with an appointment as a law clerk of the Philippine Commission. Next he was taken as the Legislative Secretary of Speaker Osmeña. Then he served as Executive Secretary of the First Philippine Independence Mission, in 1919, and in the same capacity in 1922. During the war he enlisted and became a major in the National Guard. Thereafter he was appointed Assistant Director of Commerce and Industry and later was, for a brief period, Acting Director of Posts. And finally he was made Director of the Bureau of Lands.

Outside of the Government offices, he has been equally in demand, in the field of sports and in the clubs—a popular sportsman and clubman.

Thus the new Under Secretary brings to his new position a wealth of experience as an all-around executive, remarkable for one of his youth and initial training. A home product of the public school and of the University of the Philippines, tempered in the Government service, and having the vision and elan of youth it seems certain that, he will accomplish what is expected

of him as the right-hand man of the Secretary of the Department of Agriculture and Natural Resources.

It seems a far cry from his law training and his executive experiences, to his new assigned task, but he is there on his native heath, in his boyhood environment, for he was born and raised on a farm and did his turn at the plow in the family hacienda. His father's improvement on the old wooden plow—the Vargas (Iron) Plow—might well be the principal device on the family coat of arms. * * * In entering on his new position one might say he was going back to the farm to improve on the old man's work.

J. Q. D.

FROM OUR CONTEMPORARIES

The proposed international conference of representatives of sugar exporting countries which was to have been held in Berlin in October 1928, has been postponed indefinitely. The indifference of Java to the program for international control of sugar exports caused the abandonment of the project. At the beginning high hopes for success were predicated upon adherence to the plan by Cuba, Java, Czechoslovakia, Germany, and Poland, the principal exporting countries. The European members of the conference—Germany, Czechoslovakia, and Poland—propose to maintain an international committee as an agency to promote the use of sugar.—*Facts About Sugar.*

It has been found that budgrafting will not always result in the transmission of the high yielding qualities of rubber trees; that grafted trees (in Malaya) are more susceptible to diseases than seedlings.—*Tropical Agriculture.*

The introduction and propagation of improved varieties of sugar cane has resulted in the lowering of costs of production in Java. It is stated that, with one-half of Java's sugar-cane crop made up of the variety P. O. J. 2878, the cost of its manufacture into sugar has been reduced by $\frac{1}{4}$ cent per pound. The heavier yield of this cane per unit area and the attendant economies in its handling both in the field and in the factory all account for this reduction in costs.—*The Planter and Sugar Manufacturer.*

After three months of exploration—search into the wilds of New Guinea and Papua for native and primitive varieties of sugar cane which might prove immune or resistant to the diseases and pests of the cultivated plant, Dr. E. W. Brandes of the U. S. Department of Agriculture, who headed a party of four for the purpose, reports a collection of 167 varieties. In this collection is a new species of sugar cane which produces hard, straight canes growing to a height of nearly 33 feet.—*Facts About Sugar.*

The Imperial Bureau of Entomology of Great Britain has established a "Parasite Zoo" where parasitic enemies of certain types of insects, both actual and potential, are bred.—*Tropical Life.*

BOOK REVIEW

BARRETT, OTIS WARREN. The Tropical Crops. (The Rural Science Series.) 445 pp. The Macmillan Company. New York, 1928.

"A cross between a manual and a reference book" . . ."a popular treatment of agriculture in tropical regions with a discussion of cropping systems and methods of growing the leading products," written by the Agricultural Director of the Department of Agriculture and Labor of Porto Rico, "who has had an exceptional opportunity to gain first-hand information on practically all of the crops grown in the tropics of both hemispheres."

Subjects treated of: Tropical Field Practices and Conditions Geography and Climate of Tropical Regions; Living Conditions for the Tropical Planter; Coffee; Cacao; Tea; Sugar Cane; The Citrus Fruits; The Pineapple; The Bananas; Other Tropical Fruits; The Coconut; The Oil Palm; Other Palm Products; Rubber; Other Tree Products; The Tropical Fibers; Grains and Forage; The Root Crops; Tobacco; Beverages and Masticatories; Spices; and Miscellaneous Crops.

To the Philippine farmer and industrialist, it presents a bird's-eye survey of the wide field of tropical agriculture in both hemispheres, as well as timely suggestions regarding the "dangers ahead of coffee and cacao raising, recent mistakes with coconuts and new ideas in rubber cultivation."

Each plant is dealt with in readable style, its origin, history, varieties, pests, diseases, economic status, field practices, harvesting, marketing and prospects, being given. The generous reference to Philippine crops and conditions should be of special interest to the Filipino farmer.—J. Q. D.